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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B66F 9/07, B65G 63/00 — A1

(11) International Publication Number: **WO 95/31396**

(43) International Publication Date: 23 November 1995 (23.11.95)

(21) International Application Number: PCT/KR94/00045

(22) International Filing Date: 14 May 1994 (14.05.94)

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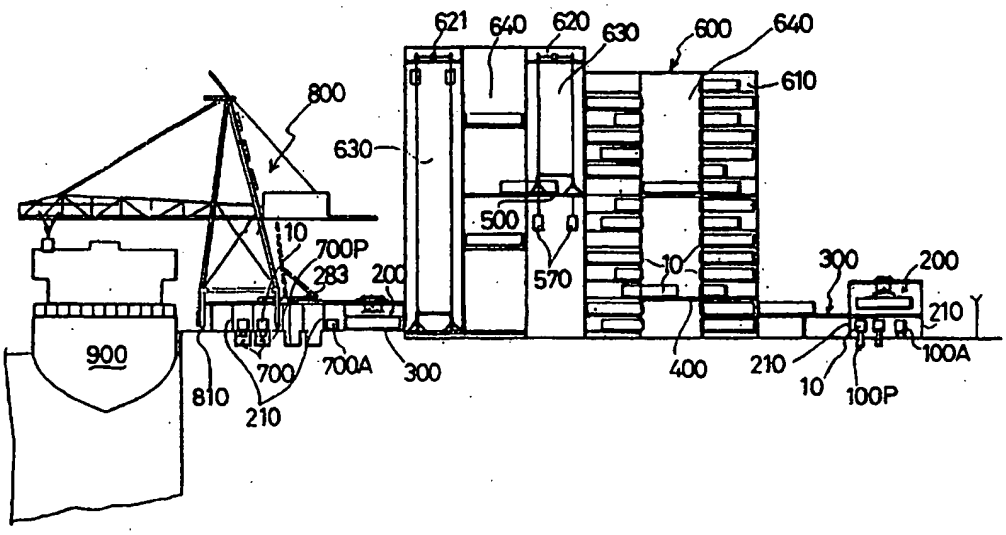
(81) Designated States: AU, BB, BG, BR, BY, CA, CN, CZ, FI, HU, JP, KP, KZ, LK, LV, MG, MN, MW, NO, NZ, PL, RO, RU, SD, SK, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: AUTOMATIC WHARFAGE SYSTEM FOR STORAGE, LOADING AND UNLOADING OF CARGO CONTAINERS



(57) Abstract

An automatic wharfage system for storage, loading and unloading of cargo containers (10). The system is automatically controlled by a management computer and includes a trailer station (100), a storage rotary crane (200), a storage conveyor unit (300), a plurality of container carts (400), a plurality of container lifts (500), a shipping conveyor unit (300), a shipping rotary crane (200), a shipping cart (700), a gantry crane (800) and a high-storied container warehouse (600) equipped with the plurality of container carts (400) and the plurality of container lifts (500). The warehouse (600) comprising an inland base building and a wharf base building standing close by and communicating with each other. The shipping carts (700) are placed at a side of the wharf base building. Storage conveyor unit (300) extends from the trailer station (100) to a second floor of the inland base building. The shipping conveyor (300) unit extends from a first floor of the wharf base building to the shipping carts (700). The storage rotary crane (200) is placed above the trailer station (100) while shipping rotary crane (200) is placed above the shipping conveyor unit (300).

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AUTOMATIC WHARFAGE SYSTEM FOR STORAGE, LOADING AND UNLOADING OF CARGO CONTAINERS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates in general to a wharfage system and, more particularly, to a wharfage system with a container warehouse for storage, loading and unloading of cargo containers.

Description of the Prior Art

Conventionally, cargo containers are shipped by rail or trailer trucks to a wharf. The containers are, thereafter, stored on an open storage yard of the wharf by a crane in accordance with an appropriate storing plan such that three or four containers are vertically heaped.

In order to move the containers such as for shipping or delivering them, the containers are moved by cranes, lifters, trailer tucks and etc. to a vessel or to a container trailer, so that the storing plan for storing the containers on the open storage yard should be precise so as to save the space of the storage yard and, at the same time, to provide smooth and short passages for the transports. Particularly with the passages for the transports, the space efficiency of the open storage yard of the wharf is inevitably deteriorated and the container storage planning uneconomically requires not only much time but also much labor. The open storage of the containers on the wharf also requires large storage yard and this makes most of the wharf area uneconomically used only as the container storage yard.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an automatic wharfage system for storage, loading and unloading of cargo containers in which the

aforementioned problems caused by the conventional wharfage can be overcome and which

is automatically controlled by a management computer and includes a trailer station, a storage rotary crane, a storage conveyor unit, a plurality of container carts, a plurality of container lifts, a shipping conveyor unit, a shipping rotary crane, a shipping cart, a gantry crane and a high-storied container warehouse equipped with the plurality of container carts and the plurality of container lifts.

In order to accomplish the above object, an automatic wharfage system according to a preferred embodiment of the present invention comprises a high-storied warehouse comprising an inland base building and a wharf base building standing close by and communicating with each other, each base building having a plurality of container storage cells, a storage cart horizontally moving a container at each story of the base building and storing the container in a desired storage cell, and a lift for lifting up the container to a desired story of the base building; a trailer station placed at a side of the inland base building and accommodating a container trailer; a plurality of shipping carts placed at a side of the wharf base building, each shipping cart being movable in parallel with the wharf base building for moving the container to a gantry crane; a first conveyor extending from the trailer station to a second floor of the inland base building for moving the container from the trailer station to the inland base building; a second conveyor extending from the wharf base building to the shipping carts for moving the container from the wharf base building to the shipping carts; a first rotary crane placed above the trailer station and running along a pair of rails in parallel with the trailer station for delivering the container of the container trailer to the first conveyor; a second rotary crane placed above the second conveyor and running along a pair of rails in parallel with the second container conveyor for delivering the container of the

second conveyor to one of the shipping carts; and a gantry crane for loading and unloading the container on and from a vessel.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figs. 1A to 1E are views of an automatic wharfage system with a container warehouse in accordance with an embodiment of the present invention respectively, in which:

Fig. 1A is a front view of the system;

Fig. 1B is a schematic plan view of the first floor of the warehouse of the system of Fig. 1A;

Fig. 1C is an enlarged plan view of the second floor of the A section of Fig. 1B;

Fig. 1D is an enlarged plan view of the first floor of the B section of Fig. 1B; and

Fig. 1E is an enlarged plan view of the second floor of the C section of Fig. 1B;

Figs. 2A to 2L are views of a rail trailer particularly used in the system of the present invention respectively, in which:

Fig. 2A is a plan view of the rail trailer;

Fig. 2B is a sectional view of the rail trailer taken along the section line B-B of Fig. 2A;

Fig. 2C is a sectional view of a power supply outlet of the rail trailer taken along the section line A-A of Fig. 2B;

Fig. 2D is a sectional view of the power supply outlet taken along the section line B-B of Fig. 2B;

Fig. 2E is a sectional view of a locking unit taken along the section line A-A of Fig. 2A;

Fig. 2F is a sectional view of the locking unit taken along the section line B-B of Fig. 2E;

Fig. 2G is a sectional view of the locking unit taken along the section line C-C of Fig. 2E;

Fig. 2H is an enlarged perspective view of a movable guider of the A section of Fig. 2A;

Fig. 2I is a plan view of a trailer moving unit of the rail trailer of Fig. 2A;

Fig. 2J is a sectional view of the trailer moving unit taken along the section line D-D of Fig. 2I;

Fig. 2K is a sectional view of the trailer moving unit taken along the section line E-E of Fig. 2J; and

Fig. 2L is an enlarged perspective view of the trailer moving unit of Fig. 2I;

Fig. 3A to 3C are views of a tractor trailer particularly used in the system of the present invention respectively, in which:

Fig. 3A is a partially broken plan view of a pallet of the trailer;

Fig. 3B is a sectional view taken along the section line A-A of Fig. 3A; and

Fig. 3C is a sectioned view taken along the section line B-B of Fig. 3A;

Fig. 4A to 4H are views of a rotary crane of the system of the present invention and its elements respectively, in which:

Fig. 4A is a plan view of the rotary crane;

Fig. 4B is a front view of the crane;

Fig. 4C is a sectional view of the crane taken along the section line A-A of Fig. 4A;

Fig. 4D is an enlarged perspective view of the A section of Fig. 4A for showing an upper body of the rotary crane;

Fig. 4E is a bottom plan view of a crane moving unit;

Fig. 4F is a front view of the crane moving unit of Fig. 4E;

Fig. 4G is an enlarged sectional view of the A section of the crane moving unit of Fig. 4F; and

Fig. 4H is a perspective view of a variable guider of

the crane moving unit;

Fig. 5A is a sectioned view of a conveyor taken along the section line A-A of Figs. 1C and 1D;

Fig. 5B is a sectioned view of a container setting guider of the conveyor taken along the section line B-B of Figs. 1C and 1D;

Figs. 6A to 6E are views of a container cart of the present invention respectively, in which:

Fig. 6A is a plan view of the cart;

Fig. 6B is a front view of the cart;

Fig. 6C is a sectioned view of the cart taken along the section line A-A of Fig. 6A;

Fig. 6D is a sectioned view of the cart taken along the section line B-B of Fig. 6A; and

Fig. 6E is a perspective view of the cart;

Figs. 7A to 7F are views of a container lift of the present invention respectively, in which:

Fig. 7A is a plan view of the lift;

Fig. 7B is a sectioned view of the lift taken along the section line A-A of Fig. 7A;

Fig. 7C is a sectioned view of the lift taken along the section line B-B of Fig. 7A;

Fig. 7D is an enlarged sectioned view taken along the section line C-C of Fig. 7A;

Fig. 7E is a sectioned view of the lift taken along the section line D-D of Fig. 7A; and

Fig. 7F is a perspective view of a body frame of the lift;

Figs. 8A and 8B are views of a pin drive unit provided in both the container cart and the container lift respectively, in which:

Fig. 8A is a plan view of the pin drive unit; and

Fig. 8B is a front view of the pin drive unit;

Fig. 9A to 9J are views of a shipping cart placed under a gantry crane and its elements respectively, in which:

Fig. 9A is a plan view of the shipping cart;

Fig. 9B is a sectional view of the shipping cart taken

along the section line A-A of Fig. 9A;

Fig. 9C is a sectional view of the shipping cart taken along the section line A-A of Fig. 9A;

Fig. 9D is an enlarged view of the A section of Fig. 9A;

Fig. 9E is a sectional view taken along the section line C-C of Fig. 9A;

Fig. 9F is a sectional view of a spline shaft of the shipping cart taken along the section line D-D of Fig. 9A;

Fig. 9G is a plan view of a power input unit of the shipping cart for supply of the electric power for the shipping cart;

Fig. 9H is a sectional view of the power input unit taken along the section line B-B of Fig. 9G;

Fig. 9I is a partially broken perspective view of the power input unit of Fig. 9G; and

Fig. 9J is an enlarged perspective view of the X portion of Fig. 9A;

Figs. 10A to 10F are views of a shipping cart in accordance with another embodiment of the present invention respectively, in which:

Fig. 10A is a plan view of the shipping cart;

Fig. 10B is a sectional view of the shipping cart taken along the section line A-A of Fig. 10A;

Fig. 10C is a plan view showing the upper and lower positions of the shipping cart;

Fig. 10D is a sectional view taken along the section line A-A of Fig. 10C;

Fig. 10E is a plan view showing a rail about a slope; and

Fig. 10F is a front view of the rail of Fig. 10E;

Figs. 11A and 11B are views of a shipping cart in accordance with further embodiment of the present invention respectively, in which:

Fig. 11A is a sectioned view of the cart taken along the section line A-A of Fig. 1B; and

Fig. 11B is a sectioned view of a guider for guiding

a container;

Fig. 12 is a bottom perspective view of a container having a structure particularly corresponding to the wharfage system of the present invention;

Fig. 13 is a perspective view showing a bottom structure of a container storage cell of the warehouse of the wharfage system; and

Figs. 14A and 14B are views of a roller equipped in each of the conveyor, the container cart, the container lift and the container storage cell of the warehouse, in which:

Fig. 14A is a front view of the roller biased by a coil spring at its lower end; and

Fig. 14B is a sectioned view of a rectangular cross-section frame supporting the roller.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to Figs. 1A to 1C, there is shown an automatic wharfage system with a container warehouse in accordance with an embodiment of the present invention.

Cargo containers 10, which are to be loaded on a vessel 900, are stored in a container warehouse 600 and taken out of the warehouse 600 to be loaded on the vessel 900 at the shipping field. When a rail trailer 100 or a tractor trailer 100A loaded with the containers 10 enters a trailer station placed aside the automatic container warehouse 600, each container 10 is lifted by a first rotary crane or a storage rotary crane 200 installed above the rail station. In lifting the container 10, the bottom center of the rotary crane 200 should be centered to the container 10. The storage rotary crane 200 loads the container 10 on a first conveyor or a storage conveyor 300 extending from the trailer station to the second floor of the warehouse 600. At this time, the container 10 is bar-coded with its weight, expected shipping date and name of vessel. When a management computer (not shown) applied with the information for the container 10 determines a storage cell number of the

container 10, this container 10 loaded on the storage conveyor 300 is automatically conveyed into the warehouse 600 and, thereafter, delivered to a transverse cart or a first cart 400 which will move this container 10 to a lift 500 in a lift well 640 of the warehouse 600. Upon reception of the container 10, the lift 500 vertically lifts up the container 10 to a desired story of the warehouse 600. When reaching the desired story of the warehouse 600, the container 10 is moved to and stored in a desired storage cell 610 by a cart 400.

In order to ship the container 10, the storage cart 400 is positioned at the front of the storage cell 610 and takes the container 10 out of the cell 610 and, thereafter, delivers the container 10 to the lift 500. The lift 500 loaded with the container 10 descends and turns over the container 10 to the shipping conveyor 300 extending to a shipping yard out of the warehouse 600. At the shipping yard, the container 10 is loaded on a shipping cart 700, 700', 700A by a shipping rotary crane 200. The shipping cart 700, 700A moves the container 10 to a shipping position under a gantry crane 800 which ships the container 10 on the vessel 900. The above process for storing the container 10 in its storage cell 610 and for shipping the container 10 on the vessel 900 is automatically carried out under the control of the management computer.

When unloading the container from the vessel 900, the gantry crane 800 unloads the container 10 from the vessel 900 and turns over it to the shipping cart 700, 700A. The container 10 is, thereafter, turned over to the shipping conveyor 300 by the shipping rotary crane 200 and turned over to the cart 400 in the warehouse 600. The transverse cart 400 loads the container 10 on the lift 500 which vertically lifts the container 10 to a desired story of the warehouse 600. When reaching the desired story of the warehouse 600, the container 10 is turned over from the lift 500 to the storage cart 400 in order to be moved to and stored in a desired storage cell 610.

When delivering the container 10 from the warehouse 600, the storage cart 400 is positioned at the front of the storage cell 610 and takes the container 10 out of the cell 610 and, thereafter, turns over the container 10 to the lift 500. The lift 500 loaded with the container 10 descends and turns over the container 10 to the storage conveyor 300 extending to the trailer station. At the trailer station, the container 10 is lifted by the storage rotary crane 200 and loaded on the rail trailer 100 or on the tractor trailer 100A.

In the above system, the conveyors 300 arranged about and inside the warehouse 600 have a similar structure. However, the conveyors 300 are provided with guiders 760G (see Fig. 11B) at sections about the rotary cranes 200. The guiders 760G guide the containers 10 when the conveyors 300 are loaded with the containers 10 by the rotary cranes 200. Particularly, the storage conveyor 300 is leveled with the second floor of the warehouse 600 while the shipping conveyor 300 is leveled with the first floor of the warehouse 600.

Referring to Figs. 2A to 2L, there are shown the rail trailer 100 and its elements respectively. This rail trailer 100 includes a container support plate 110 for supporting the container 10 thereon. This support plate 110 is provided with a plurality of locking units 120 which are locked to locking holes 11 formed on corners of the container 10. The locking units 120 are such arranged on the plate 110 that they reliably accommodate all sizes of containers 10. At a side of each locking unit 120, the rail trailer 100 is provided with a movable guider 130 (see Fig. 2H) which is driven by a motor 130M and guides a corresponding corner of the container 10. The container support plate 110 of the trailer 100 is also provided with a pair of power supply outlets 140. The power supply outlets 140 are placed at the front and rear sections of the plate 110 respectively. The rail trailer 100 also includes front wheels 100W and rear wheels 100W. These wheels 100W

are rotatably supported by their respective shafts 100S and roll on the rails 100R.

As shown in Fig. 2K, a pit 100P is provided in the ground between the rails 100R and receives therein a trailer moving unit 150.

Each locking unit 120 will be described in detail hereinbelow in conjunction with Figs. 2E to 2G. The locking unit 120 includes a pin head 121 which is received in a guide hole 111 of the support plate 110. A pin shaft 122 of the pin head 121 is received in a case bracket 123 and vertically movable. This pin shaft 122 shows a rectangular section at its middle portion 122a. The case bracket 123 is provided with a fixing channel 124 to which a hydraulic cylinder $120C_1$ is hinged. An actuating rod $120R_1$ of the hydraulic cylinder $120C_1$ is hinged at its free end to a rotary lever 125 which is in turn coupled at its middle section to the rectangular cross-sectioned portion 122a of the pin shaft 122. The rotary lever 125 extends behind the rectangular cross-sectioned portion 122a of the pin shaft 122 and rounded at its free end. The rounded free end of the rotary lever 125 comes into movable contact with and slidably moves on a rounded guide surface 123a of the case bracket 123 as shown in Fig. 2F. The pin shaft 122 penetrates a ball-shaped middle section 126a of a seesaw lever 126 and tightly engaged with a pair of nuts 127 on and under the ball-shaped section 126a. The engagement of the nuts 127 with the pin shaft 122 is achieved by a screw type fitting. The nuts 127 come into contact with the top and bottom surfaces of the ball-shaped section 126a of the seesaw lever 126 respectively and ascend or descend in accordance with levering motion of the seesaw lever 126 about a hinged point, thus cause the pin shaft 122 to be lifted up or downed. As shown in Figs. 2F and 2G, one end of the seesaw lever 126 extends out of the case bracket 123 and hinged to the outer surface of the bracket 123, thus to provide the hinged point about which the lever 126 is turned. However, the other end of the seesaw lever 126 is

hinged to an actuating rod $120R_2$ of a hydraulic cylinder $120C_2$. The actuating rod $120R_2$ pushes or pulls the other end of the seesaw lever 126 such that this lever 126 is turned about the hinged point at the outside of the case bracket 123. The hydraulic cylinder $120C_2$ is hinged to the top section of the case bracket 123.

Turning to Fig. 2H, there is shown the movable guider 130 driven by the motor 130M. The movable guider 130 is positioned about the guide hole 111 of the support plate 110 of the trailer 100 and comprises an L-shaped guide panel 131 which is bent at right angle. The L-shaped guide panel 131 is horizontally coupled at its bottom side to the reversible motor 130M. The motor 130M including reduction gears is fixed to the bottom surface of the support plate 110. At a position aside the guide hole 111, the support plate 110 has a cutout portion 112 for allowing the guide panel 131 to appear and disappear therethrough in accordance with forward and reverse rotation of the reversible motor 130M.

The power supply outlets 140 provided at the front and rear sections of the support plate 110 receive power plugs of the trailer moving unit 150 as shown in Figs. 2C and 2D. Each power supply outlet 140 comprises a rectangular cap housing 143. A plurality of guide panels 142 biased by their torsion springs 141 are hinged to lower ends of the cap housing 143 such that they are folded and received in the cap housing 143 when the power plug of the unit 150 is inserted into the cap housing 143 as shown in Fig. 2D. A power outlet body 144 having a plurality of terminals 144a at its bottom surface is received in the cap housing 143. This power outlet body 144 is movably fitted on opposed vertical guide rods 145 of the housing 143 and biased by coil springs 145a fitted over the rods 145 above the body 144. Hence, when the outlet body 144 engages with the power plug of the unit 150, the mechanical shock generated in the engagement between the body 144 and the power plug is reliably absorbed. Rectangular cross-sectioned columns 146 which are fixed to the bottom surface of the support plate

110 are connected to the top surface of the cap housing 143. These columns 146 can slide leftward and rightward on the cap housing 143. A pair of guide rods 147, that is, an X-directional rod and an Y-directional rod are fixed to a guide bracket 148 which is in turn mounted on the cap housing 143 between the rectangular columns 146. The guide rods 147 are elastically supported by their respective coil springs 147a at their opposed sides. The springs 147a are fitted over the guide rods 147 and stopped by the side surfaces of the columns 146.

The trailer moving unit 150 is shown in detail in Figs. 2I to 2L. The moving unit 150 comprises a pair of I-beam rails 151 lengthwise laid on the bottom of the pit 100P. Each rail 151 is formed with a rack 151a on its top surface. The rails 151 having the racks 151a are engaged with front and rear pairs of rollers 152R and guide these rollers 152R. The rollers 152R are rotatably mounted on the front and rear sections of a pair of connector bodies 152 by front and rear shafts 152S.

The connector bodies 152 include their respective bushes 152b for supporting the shafts 152S. In this case, opposed channels of the bodies 152 are connected at their bottom sections to each other by a connection plate 152a.

One of the front and rear shafts 152S is provided with a sprocket 152s. This sprocket 152s cooperates with a motor 152M through a chain 152c connecting them to each other. The motor 152M includes a clutch and reduction gears and fixedly mounted on the bodies 152.

A hydraulic cylinder 153C is vertically provided on the top center of the bodies 152. The actuating rod 153R of the cylinder 153C is fixed to a longitudinal beam 153a. A pair of chain case frames 153 are fixed to opposed ends of the longitudinal beam 153a and each has a rack guide recess 153b at its bottom as shown in Fig. 2K. Each frame 153 is provided with a pair of sprockets 153s at each end thereof. Additionally, subsidiary sprockets 153s are provided in each frame 153.

A motor 153M having reduction gears is provided between the frames 153. Opposed output shafts 153S of the motor 153M extend from the reduction gears and are coupled to their corresponding sprockets 153s for driving these sprockets 153s.

The racks 151a of the rails 151 are placed just below the lower recesses 153b of the case frames 153e and engaged with chains 153c wrapped about the sprockets 153s.

A rectangular column 154 including a hydraulic cylinder 152C is vertically fixed to the center of the bodies 152. The rod 152R' of the cylinder 152C is connected to a vertically movable guide column 155 which is movably received in the rectangular column 154. A guide frame 156 including a hydraulic cylinder 156C is fixed at its center to the top of the guide column 155 such that it shows T-shaped appearance in cooperation with both the guide column 155 and the rectangular column 154. The opposed rods 156 of the hydraulic cylinder 156C are hinged at their ends to guide frames 157, each frame 157 having two pairs of rollers 157R. The power plug 156a, which will be engaged with the power supply outlet 140 of the support plate 110 of the trailer 100, is provided on the center of the guide frame 156. The trailer moving unit 150 also includes power connection means 159 which will be connected to trolley wires 158 of the pit 100P.

Turning to Figs. 3A to 3C, there is shown a pallet unit 160 of the tractor trailer 100A in accordance with the present invention. The pallet unit 160 is placed in a working range of the storage rotary crane 200. This pallet unit 160 comprises a pair of rod frames 161 which are fixedly placed on the bottom center of a pit 160. The rod frames 161 are spaced out at a regular interval. A pair of actuating rods 162 extend in parallel between the two rod frames 161 and receive a reciprocating cylinder 162C thereon and cooperates with this cylinder 162C.

A pair of frames 162a extending outward from opposed sides of the reciprocating cylinder 162C are fixed to and

support thereon two pairs of I-beam support frames 163. The two pairs of frames 163 are axially placed on opposed top sides of the frames 162a for supporting opposed sides of a pallet 166. At opposed sides of the reciprocating cylinder 162C, a pair of channel support members 164 are axially placed on the bottom of the pit 160P and support bearings 165 respectively. A roller 165R is coupled to each bearing 165 and guided between its support frames 163. At this time, the rollers 165R are positioned at the outside of stroke range of the reciprocating cylinder 162C.

A plurality of protruding pallet portions 167 are provided on front and rear opposed sides of the pallet 166 and received in their respective guide slits 168a. A guider 168 having a plurality of rollers 168R for supporting and guiding the pallet portions 167 is placed under the pallet 166.

As shown in Figs. 1A and 1B, the rotary cranes 200 are installed on four sections of the warehouse 600. The storage rotary cranes 200 are installed on upper section of the second floor of the warehouse 600 while the shipping rotary cranes 200 are installed on upper section of the first floor of the warehouse 600.

Referring to Figs. 1C and 4A to 4H, there is shown a storage rotary crane 200 of the present invention. In order to achieve a desired movable support for the rotary crane 200, a pair of first running rails 220A are supported on vertical columns 210. The rails 220A are parallel to each other and have a width wider than the width of pallet unit 160. The first running rails 220A let the rotary crane 200 move transversely. A pair of predetermined length of first roller frames 230A, which have rollers $230R_1$ provided with their motors $230M_1$, are movably laid on the first rails 220A. A pair of second running rails 220B which make the rotary crane 200 moving lengthwise, extend between the first roller frames 230A at opposed sides of the roller frames 230A. The second running rails 220B and the roller frames 230A form a rectangular frame letting the rotary crane 200

move lengthwise and transversely above the rail trailer 100 or the tractor trailer 100A. As shown in Fig. 4A to 4H, a pair of second roller frames 230B, each including rollers $230R_2$ at its opposed ends, are fixedly connected to each other by a pair of spaced connection beams 231. A roller shaft 230S extend between a pair of rollers $230R_2$ for making the rollers $230R_2$ rolling on the second running rails 220B. The roller shaft 230S has a drive motor $230M_2$ at its center and transmits the rotational force of the motor $230M_2$ to the rollers $230R_2$, thus to rotate these rollers $230R_2$ and to makes them rolling on the second running rails 220B. A support plate 232 having a wire hole 232a is fixed on one of the connection beams 231 and is provided with stationary hydraulic cylinder 232C. A pair of sheaves 233C are mounted on the rod 232R of the hydraulic cylinder 232C by a sheave shaft 233S. The sheave shaft 233S is guided and supported by a pair of T-shaped rails 234 of a predetermined length. The T-shaped rails 234 are fixed on a subsidiary support member 231A by a support channel 235. At the back of the support plate 232, a pair of sheaves 236C are mounted on a bracket 236 by a shaft, thus to form the upper body 230 of the rotary crane 200. The crane 200 also includes a lower body 240. The lower body 240 comprises a rectangular frame 241 whose desired structural strength is achieved by its longitudinal frame 241A and its transverse frame 241B. The frame 241 is provided with sheaves 241C placed under the outside sheaves 233C and 236C of the upper body 230 as shown in Fig. 4B. Bushes 243 having their bearings 242 at their centers are provided at the center of the lower body 240. Strong wires W, whose one ends are fixed to the support plate 232 of the upper body 230, are wrapped about and extend between the inside sheaves 233C and 236C of the upper body 230 and, thereafter, extend to the outside sheaves of the upper body 230 in order to be wrapped about and extend between them. At this time, the wrapping of the wires W is achieved due to the fact that there is formed the wire hole 232a in the support plate 232. The wires W wrapped about

the inside and outside sheaves of the upper body 230 in turn extend to one sheave 241C of the frame 241 of the lower body 240 in order to be wrapped about it and, thereafter, extend to the other sheave 241C in order to be wrapped about the other sheave 241C prior to their fixing to a bottom surface of the support plate 231 as best seen in Fig. 4C.

The lower body 240 rotates a container grip unit 260 coupled to a shaft 250S of a rotary unit 250. The rotary unit 250 includes a plurality of downward inclining frames 251 which are mounted on the shaft 250S at their inside ends and fixed to a predetermined diameter annular frame 252 at their outside ends as shown in Figs. 4E to 4G. A concentrical disc 253, to which a plurality of radial support frames 254 are fixed at their inside ends, is mounted on the shaft 250S. The radial frames 254 are fixed to the annular frame 252 at their outside ends, so that the rotary unit 250 achieves a desired structural strength. A chain 252c wrapped about the annular frame 252 is also wrapped about a sprocket 240s which is rotated by the rotational force of a motor 240M mounted at a side of the lower body 240. The rotational force of the motor 240M is transmitted to the sprocket 240s through the reduction gears of the motor 240M and in turn transmitted to the annular frame 252 through the chain 252c, thus to rotate the annular frame 252. A plurality of rollers 255R are rotatably supported by their support brackets 255 which are placed under the annular frame 252 such that they are spaced out at regular intervals.

Here, the shaft 250S tightly penetrates the bushes 243 of the lower body 240 at its lower section. The protruding lower end of the shaft 250S is fixed to the container grip unit 260 as best seen in Fig. 4G.

The container grip unit 260, which is fixed to the protruding lower end of the shaft 250S of the rotary unit 250, is adapted for gripping the container 10 in lifting operation the container 10. As shown in Figs. 4F and 4G, the grip unit 260 comprises longitudinal frames 261A and

transverse frames 261B which are fixed to and heaped on the center of an elongated rectangular frame 261.

The frames 261A and 261B are also fixed to the shaft 250S of the rotary unit 250. The rectangular frame 261 is horizontally suspended by four tensile rods 262 which extend between the shaft 250S of the rotary unit 250 and the four corners of the frame 261 and are adjusted in their tensile forces by adjusting their respective turn buckles 262T.

In order to achieve more stable suspension of the rectangular frame 261, it is preferred to provide a pair of transverse frames 261b for the rectangular frame 261 and to weld the tensile rods 262 to the transverse frames 261b at welded portions 262A of the rods 262. The rectangular frame 261 also includes a plurality of hydraulic cylinders 263c which have their locking pins 263. The pins 263 of the cylinders 263c will be detachably locked to the locking holes 11 of the containers 10. A plurality of slant panels 264 are provided on the bottom surface of the rectangular frame 261 so as to guide 40 ft. sized containers. The rectangular frame 261 further includes a pair of variable guiders 270 for centering the varieties of containers 10. As shown in Fig. 4H, each of the variable guiders 270 comprises a hydraulic cylinder 270C hinged to the rectangular frame 261. The actuating rod 270R of the cylinder 270C is hinged to a guider 271 which is coupled to a support bracket 273 of the rectangular frame by a pin. The guider 271 comprises a stepped section 272 and an inclined section 271A extending from the stepped section 272. This guider 271 is turned about the pin of the bracket 273 at a predetermined angle in accordance with linear reciprocating motion of the actuating rod 270R of the hydraulic cylinder 270C.

Here, the stepped section 272 of the guider 271 is for stopping of the container 10 in the vertical direction.

As shown in Fig. 1, in order to move the storage rotary cranes 200 and the shipping rotary cranes 200, the storage conveyor 300 for storing or delivering the containers 10 in

or from the warehouse 600 is laid such that it is leveled with the second floor of the warehouse 600. In addition, the shipping conveyor 300 for moving the containers 10, which containers 10 were unloaded from the vessel 900 or will be shipped on the vessel 900, is laid such that it is leveled with the first floor of the warehouse 600. As shown in Figs. 1C and 5A, the storage conveyor 300 comprises at least one conveyor which comprises a pair of rectangular cross-sectioned frames 320 which are laid in parallel on a lattice frame 310. A plurality of inside rollers 321 are rotatably mounted on the inside surface of the frames 320 and spaced out at regular intervals. In addition, a plurality of spring-biased rollers 322 are rotatably mounted in each frame 320 such that they are spaced out at regular intervals. The rollers 322 are biased by their respective springs S at their lower ends. At the inside of the inside rollers 321, a pair of chain guide frame 330 are placed such that they are spaced apart from their corresponding rollers 321 by a predetermined distance. Each of the chain guide frame 330 has a finger guide recess thereon and a chain 330c therein. The chain 330c is wrapped about a sprocket 330s of a shaft 330S and rotated by the rotational force of a motor 330M. A plurality of regularly spaced fingers 340 are provided on the chain 330c.

The storage conveyor 300 is provided with folding guiders 350 for guiding the container 10 and achieving a precise setting of the container 10 on the conveyor 300. As shown in Fig. 5B, each guider 350 is hinged to the side surface of the cross-sectioned frame 320 and levered by a link motion of a link 350L. The link 350L is hinged to an actuating rod of a hydraulic cylinder 350C fixed to the bottom surface of the rectangular cross-sectioned frame 320. The guider 350 is formed with a step portion 350A, so that it substantially meets with the angled corner of the rectangular cross-sectioned frame 320 when erected in order to guide and set the container 10 on the conveyor 300.

The containers 10 which entered the warehouse 600 under

the guide of the storage conveyor 300 are turned over either another conveyor 300 or the conveyor lift 500 so as to be moved to their storage cells 610 of the warehouse 600 prior to their storage in the cells 610. Alternatively, the containers 10 may be directly shipped on the vessel 900 after simple passing through the warehouse 600. In order to directly ship the containers 10 on the vessel 900, the containers 10 which entered the warehouse 600 by the storage conveyor 300 are turned over the warehouse conveyor 300 by the storage cart 400 and, thereafter, simply pass through the warehouse 600 in order reach the shipping yard out of the warehouse 600. The containers 10 out of the warehouse 600 are turned over to the shipping conveyor 300. This shipping conveyor 300 conveys the container 10 to a position under the shipping rotary crane 200.

As described above, the warehouse 600 is equipped with a plurality of carts 400 having the same structure. Figs. 6A to 6E show an example of the carts 400 provided in the warehouse 600. The cart 400, running along a cart running passage 640, includes a rectangular frame 410 which is provided at its four corners with transverse running rollers 410R. One of the rollers 410R is coupled to a roller shaft 410S which is rotated by the rotational force of a drive motor 410M having reduction gears and clutch. The rectangular frame 410 is thus moved transversely on a pair of spaced cart rails 400R. The lengthwise movement of the cart 400 is achieved as follows. A pair of chains 450C, having their pin drive units 450 for driving their locking pins locked to the locking holes 11 of the container 10, lengthwise extend and are wrapped about sprockets 450s. Each chain 450C is guided by a chain guider 452 fixed onto a support bracket 451. A drive motor 450M having reduction gears is provided at the center of the cart 400 and coupled to opposed center sprockets 450s through its opposed output shafts 450S. The center sprockets 450s are transmitted with the rotational force of the motor 450M and rotated in the same direction, thus to drive their chains 450C. At the

inside of the chain guiders 421, a pair of rectangular cross-section frames 420 are placed such that they are spaced apart from their corresponding guiders 421 by a predetermined distance. A plurality of regularly spaced inside rollers 421 are mounted on the inside surfaces of the frames 420 for supporting the container 10 thereon. In addition, a plurality of spring-biased rollers 422 are rotatably mounted in each frame 420 such that they are spaced out at regular intervals. The rollers 422 are biased upward by their respective coil springs S. The rectangular cross-sectioned frames 420 are fixed at their opposed ends on a pair of support frames 411 of the rectangular frame 410, thus to provide a passage for the containers 10. Here, the rectangular cross-sectioned frames 420 has the same structure and the same width of the rectangular cross-sectioned frames of both the conveyor 300 and the lift 500.

In order to let the frames 420 substantially meet with both the conveyor 300 and the lift 500, each of the frames 420 is provided at its opposed ends with lock pins 421a driven by their hydraulic cylinders 420C.

At the inside of the inside rollers 421, a pair of chain guiders 432 are placed in parallel such that they are spaced apart from their corresponding rollers 421 by a predetermined distance. Each of the chain guiders 432 has a finger guide recess 432a thereon and receives a chain 430c therein. The chain 430c is wrapped about a sprocket 430s of a shaft 430S and lengthwise driven by the rotational force of a motor 430M having reduction gears. A pair of opposed fingers 430 are provided on each chain 430c. Each chain guider 432 is formed with an elongated upper channel 432A having the finger guide recess 432a thereon. A pair of lower channels 432B are provided under the upper channels 432A and form a box-shape line. The chains 430C are received in and guided by the chain guiders 432 which are fixed to the support brackets 431. Each chain guider 432 includes a pair of shoe angles 433 which are mounted on their corresponding guide rails 434 and fixed to the support

brackets 431. A reciprocating cylinder 440C having opposed rollers 440R is fixed to the support bracket 431. A guide rail 441 is mounted on the support frames 411 of the rectangular frame 410 and fixed to rod frames 442 at its front and rear ends respectively. A pair of guide rods 443 extend between and are fixed to the rod frames 442. Hence, the rollers 440R of the reciprocating cylinder 440C are guided by the guide rails 441 respectively.

Turning to Figs. 8A and 8B, there is shown a pin drive unit 450. The pin drive unit 450 includes a pair of rollers 454 which are rotatably mounted on opposed bottom surfaces of a base plate 450. The base plate 450 is coupled to the chains 450c at its front and rear ends and guided by the chain guiders 452. A pin 455 is connected to a drive motor $455M_1$ through worm and worm gear engagement and appears and disappears in accordance with rotation of the motor $455M_1$. A positional sensing lever 456 for sensing an angle base position is biased by a torsion spring 456a and driven by a motor $455M_2$. The motor $455M_2$ is fixed to an angle base 457 which is hinged by a pin 457a. The angle base 457 is rotated in accordance with sensing result of the positional sensing lever 456. A shock absorbing spring 458a is provided on the angle base 457. The angle base 457 cooperates with a limit switch 459. A stopper 458b having a recess is provided about an end of the angle base 457 for limiting the moving range of the angle base 457.

As described above, the aforementioned cart 400 turns over the container 10 to the conveyor 300. The container 10 loaded on the conveyor 300 is in turn turned over to the lift 500 and lifted by the lift 500 to a desired storage floor of the warehouse 600. Upon reaching a desired storage floor, the container 10 is stored in a storage cell 610 by a cart 400 running in that floor.

Hereinbelow, the construction of the lift 500 will be described in detail in conjunction with Figs. 7A to 7F. The lift 500 includes a rectangular frame 510 which is provided with a pair of chains 550c lengthwise placed. Each chain

550c includes a pin drive unit 450 in the same manner described for the cart 400. The chain 550c is wrapped about a sprocket 550s which is coupled to a shaft 550S of a drive motor 550M. The sprocket 550s is rotated by the rotational force of the motor 550M and drives the chain 550c. A support bracket 551 and a chain guider 552 are provided for the lift 500 for supporting the lift 500 and guiding the chain 550c respectively. As shown in Fig. 7D, a base 546 not only having a rack portion 544 at its bottom surface but also having protrusions 545 at its opposed sides is guided by a guide rail 547 between the frames 510 and 520 which will be described in detail hereinbelow. A gear 560G is coupled to a shaft 560S of a motor 560M which is mounted on the transverse frame 511 of the rectangular frame 510.

At the inside of the chain guiders 552, a pair of rectangular cross-section frames 520 are placed such that they are spaced apart from their corresponding guiders 552 by a predetermined distance. A plurality of regularly spaced inside rollers 521 are mounted on the inside surfaces of the frames 520 for supporting the container 10 thereon in the same manner as described for the cart 400. In addition, a plurality of spring-biased rollers 522 are rotatably mounted in each frame 520 such that they are spaced out at regular intervals. The rollers 522 are biased upward by their respective coil springs S. The rectangular cross-sectioned frames 520 are fixed at their opposed ends on a pair of support frames 511 of the rectangular frame 510, thus to provide a passage for the containers 10. At the inside of the inside rollers 521, a pair of chain guiders 532 are placed in parallel such that they are spaced apart from their corresponding rollers 521 by a predetermined distance. Here, the width between the chain guiders 532 is different from or more wider than that of the chain guiders 432 of the above-described cart 400. Each of the chain guiders 532 has a finger guide recess 532a thereon and receives a chain 530c therein. The chain 530c is wrapped about a sprocket 530s of a shaft 530S and lengthwise driven

by the rotational force of a motor 530M having reduction gears. A pair of opposed fingers 530 are provided on each chain 530c. Each chain guider 532 is formed with an elongated upper channel 532A having the finger guide recess 532a thereon. A pair of lower channels 532B are provided under the upper channels 532A and form a box-shape line. The chains 530c are received in and guided by the chain guiders 532 which are fixed to the support brackets 531.

A reciprocating cylinder 540C having opposed rollers 540R is fixed to the support bracket 531 as shown in Fig. 7E. A guide rail 541 is mounted on the support frames 511 of the rectangular frame 510 and fixed to rod frames 542 at its front and rear ends respectively. A pair of guide rods 543 extend between the rod frame 542 and are fixed to those rod frames 542 at their ends. Hence, the rollers 540R of the reciprocating cylinder 540C are guided by the guide rails 541 respectively. As will be noted from the above description, the structure of the lift 500 is similar to that of the cart 400, however, the width of the lift 500 is different from that of the cart 400.

The lift 500 ascends and descends in a lift well 630 of the warehouse 600. In order for smooth vertical movement of the lift 500 in the lift well 630, the four corners of the rectangular frame 510 are provided with rollers 510 rolling on rails 500R of the lift well 630 as shown in Fig. 7A. Four columns 512 are vertically provided on the rectangular frame 510 and connected to each other at their uppermost ends by horizontal beams 513, thus to form a rectangular frame. A wire rope W is coupled to each of the four corners of the rectangular frame formed by the columns 512 and the beams 513 and wrapped about and driven by a winch 621 of the penthouse 620 of the warehouse 600 as shown in Fig. 1A. The lift 500 is also provided with weights 570 for achieving desired balance of the lift 500.

The container 300 coming out of the warehouse 600 by the shipping conveyor 300 is turned over to a shipping cart by the shipping rotary crane 200 having the same structure

as the storage rotary crane 200. The structure of the shipping cart 700 in accordance with an embodiment of the present invention is represented in detail in Figs. 9A to 9J.

As shown in Figs. 9A and 9D, the shipping cart 700 includes a cart frame 720 which is seated on a pit 700P. This cart frame 720 is provided at its four corners with rollers 711 which are supported by their support arms 712 and seated on the edge of the pit 700P. Each of the rollers 711 is rotated by the rotational force of its motor 710M having reduction gears. A pair of buffers 713 are provided at the front and rear ends of the shipping cart 700 for absorbing mechanical shock which may be generated when the carts 700 collide on each other.

As shown in Fig. 9A, the cart frame 720 includes two pairs of longitudinal beams 721. In addition, the frame 720 includes a plurality of regularly spaced transverse beams 722. A pair of plate springs 731 are provided under the longitudinal beam 721 at every corner. Each plate spring 731 is supported on a bracket 732 at its bottom center and mounted on the spring seat 721a of the frame 720 at its opposed ends as best seen in Fig. 9B. A plurality of wheels 740W are mounted on opposed sides of front and rear sections of the bracket 732. A power input unit 750 is provided on either side of the bracket 732.

Turning to Figs. 9E and 9F, a wheel shaft 740S of the spline shaft type is vertically guided in a guide recess 723a of a guide plate 723. The guide plate 723 extends downward from the longitudinal beam 721 of the cart frame 720. As shown in figs. 9A and 9J, a hydraulic cylinder 732C is fixed to a side of the bracket 732. The actuating rod 732R of the cylinder 732C fixes a shaft loading plate 732b to the wheel shaft 740S and causes this loading plate to cooperate with the wheel shaft 740S, thus to allow the wheel 740W to appear or disappear. Two-stage hydraulic cylinders 720C are vertically provided on bottom channels 732a extending between the brackets 732. These two-stage

hydraulic cylinders 720C have their actuating rods 720R which are fixed to the transverse beams 721. The hydraulic cylinders 720C lift up the cart frame 720. A panel 714 is mounted on the cart frame 720 such that it covers all the frame 720.

Drive parts of the cart 400 are provided on the lower body of the cart 400. The front or rear wheel shafts 740S are provided with chain sprockets $740s_2$ at their middle portions and rotated by the rotational force of a motor 740M. For example, the pair of rear shafts 740S have their sprockets $740s_2$ at their middle portions. A middle sprocket $740s_1$ driven by a motor 740M is placed between the two sprockets $740s_2$ and rotates the sprockets $740s_2$ by the rotational force of the motor 740M. The sprockets $740s_1$ and $740s_2$ are connected to each other by chains 740c, so that the sprockets $740s_2$ are rotated when the middle sprocket $740s_1$ is rotated by the rotational force of the motor 740M. Thus, the wheels 740W are rotated and run along upper or lower rails $740R_1$ and $740R_2$. The upper and lower rails $740R_1$ and $740R_2$ are projected from the side walls of the pit 700P and vertically spaced apart from each other as shown in Fig. 9C.

As shown in Fig. 9C, the pit 700P is provided with the upper and lower rails $740R_1$ and $740R_2$ which are horizontally projected inside from the side walls of the pit 700P. A pair of trolley wires 751A and 751B are lengthwise placed on the opposed side walls of the pit 700P. The shipping cart 700 has the power input unit 750 which is provided either side of the bracket 732 and selectively engaged with the trolley wires 751A and 751B of the pit 700P, so that the shipping cart 700 is supplied with the electric power while running along the rails $740R_1$ and $740R_2$.

The power input unit 750 is represented in detail in Figs. 9G to 9J. As shown in these drawings, the power input unit 750 includes a bracket 751 fixed to a side bottom of the longitudinal beam 721 of the cart frame 720. A hydraulic cylinder 750C having an actuating rod 750r is

fixed to the bracket 751. The actuating rod 750r is also fixed to a slide member 753 received in a hollow box 752 having both an elongated cavity 752a therein and a trolley terminal 752b at its outside. The slide member 753 is biased by a coil spring 753a and vertically slides in the box 752. The power input unit 750 corresponding to the lower trolley wire 751B has the same structure as described above and fixed to the inside upper surface of the bracket 732.

Please note that the aforementioned shipping cart 700 has a structure suitable for accommodating a conventional container. However, the new container 10 of the present invention needs no cart and pit. That is, the shipping cart 700A corresponding to the new container 10 of the present invention includes a plurality of rollers 760R received in guide grooves 12 formed on the bottom surface of the container 10 as shown in Fig. 11A. The rollers 760R are rotatably received in a pair of rectangular cross-sectioned frames 760 and connected to each other by a shaft 760S extending therebetween. One of the rollers 760R is connected to a motor 760M and rotated by the rotational force of the motor 760M having reduction gears, so that the rollers 760R connected to each other by the shaft 760S are rotated at the same time in order to move the shipping cart 700A. A plurality of positional sensors 761 are provided between the shafts 760S as shown in Fig. 1B. With the positional sensors 761, the shipping cart 700A is stopped when the container 10 has passed.

The rectangular frames extending between the warehouse 600 and the storage rotary crane 200 as shown in Fig. 1D and the rectangular frames extending between the warehouse 600 and the shipping rotary crane 200 as shown in Fig. 1C are provided with guiders 760G respectively. One of the guiders 760G is shown in Fig. 11B. Each of the guiders 760G, having a stepped portion 760A at its lower section, is driven by a hydraulic cylinder 760C and a link 760L.

The shipping cart of this invention may be suspended

using support columns as shown in Figs. 10A to 10F. The suspended shipping cart 700' has the similar construction to that of the above cart 700 or 700A received in the pit 700P. However, since this suspended cart 700' is suspended using the support columns, it needs no pit 700p. Most of the elements of the shipping cart 700' are common with those of the shipping cart 700. Those elements common to both the cart 700 and the suspended cart 700' will thus carry reference numerals which differ by " ' ". The suspended cart 700' includes several pairs of opposed support columns 770 which are vertically placed on the opposed ground running passages and spaced out at regular intervals. Upper and lower beams 771 extend between each pair of support columns 770 as shown in Fig. 10B. Each of the upper and lower beams 771 is provided with a pair of spaced rails $740R_1$' or $740R_2$'. The wheel shaft 740S' of this suspended shipping cart 700' has no spline coupling portion. In another embodiment, the upper rails $740R_1$' laid on the upper beam 771 and supporting the wheels 740W' thereon are coupled to actuating rods of their hydraulic cylinders 780C placed on the support columns 770 as shown in Fig. 10D. In this case, the rails $740R_1$' are linearly moved on the upper beam 771 in order to make their width narrower or wider. In order to trail the shipping cart 700' on a slope, a sprocket 790 about which a chain 790c is wrapped is mounted on the outside of the wheel 740W' as shown in Fig. 10E.

The upper trolley wire 751A' of the cart 700' is provided on one of the support columns 770 such that it directs downward as shown in Fig. 10B. The lower trolley wire 751B' of the cart is provided on the upper center of the lower beam 771 such that it directs upward. In order to meet with the upper and lower trolley wires 751A' and 751B', the lower power input unit 750' of the cart 700' is provided on the bottom surface of the bottom channel 732a' such that it directs downward. Another power input unit of the cart frame 720' has the same structure as shown in Fig. 9I but directs upward.

On the shipping yard out of the warehouse 600, the gantry crane 800 for loading and unloading the containers 10 on and from the vessel 900 is horizontally moved along the rails 810 laid on opposed sides of the shipping carts 700, 700A. Here, the transverse running rails 810 for the gantry crane 800 and the first running rails 220A cross each other, so that there may be interference between the lengthwise movement of the shipping rotary crane 200 along the running rails 220A and the transverse movement of the gantry crane 800 along the running rails 810. In order to prevent such an interference between the lengthwise movement of the shipping rotary crane 200 and the transverse movement of the gantry crane 800, a hinge 281 is provided on a predetermined position of each first running rail 220A at the outside of the shipping cart as shown in Fig. 1D. Actuating rods 282 of a pair of opposed hydraulic cylinders 283 are hinged to the hinges 281 of the first running rails 220A. When the gantry crane 800 should pass on the tails 810 crossing the first running rails 220A, the actuating rods 282 of the cylinders 283 retract so as to lift up their running rails 220A toward the warehouse 600. After passing of the crane 800, the rods 282 extend so as to return the rails 220A to their horizontal positions and to allow the lengthwise movement of the shipping rotary crane 200 along the first running rails 220A.

Fig. 13 is a perspective view of one of the storage cells 610 of the warehouse 600 of the automatic wharfage system of the present invention. The storage cell 610 includes a rectangular frame 611 which is provided with a plurality of rollers 612 which are biased by their springs S. The rollers 612 are appropriately spaced in order to accommodate all sizes of containers. The frame 611 is also provided with a plurality of inside rollers 613 which are rotatably mounted on the inside surfaces of the frames 611. Opposed rear side ends of the rectangular frame 611 are provided with stoppers 614. These stoppers 614 stop a longest container. The rectangular frame 611 is sloped

downward from its input side to its rear side at a gradient of 3/1200.

On the other hand, the tractor trailer 100A includes the plurality of locking units 120 and the movable container guiders 130 which are arranged on the container support plate in the same manner as described for the support plate 110 of the rail trailer 100.

In the automatic wharfage system of the present invention, all of the rollers provided in the conveyors 300, carts 400, lifts 500 and storage cells 610 of the warehouse 600 have the same structure. One of the rollers is represented in detail in Figs. 14A and 14B. As shown in these drawings, the roller R is placed in the rectangular cross-sectioned frame A such that it somewhat protrudes out of the upper opening "a" of the frame A. A roller shaft Rs is seated at its opposed ends in guide holes "b" formed in opposed side walls of the frame A. A bracket B covers both the outside bottom and opposed sides of the frame A and supports the opposed ends of the roller shaft Rs. A coil spring S is provided under the outside bottom of the bracket B for biasing the bracket B upward. This spring S is received in a spring support frame C.

As shown in Fig. 12, the container 10 used in the wharfage system of this invention is formed with the lengthwise guide grooves 12 at its opposed outside bottom. The guide grooves 12 of the container 10 are seated on the inside rollers of the frame and guided by the inside rollers. Opposed ends 12a of each guide grooves 12 are widened so as to achieve smooth reception of the rollers.

In the automatic wharfage system of this invention, all the motors should have their reduction gears and selectively have their clutches.

Hereinbelow, the layout for the automatic wharfage system of this invention will be described. As shown in Fig. 1A, the trailer station is placed aside the warehouse 600 for accommodating the rail trailers 100 and the tractor trailers 100A. The trailer station is provided with the

storage rotary cranes 200 for loading and unloading the containers 10 on and from the trailers 100 and 100A. The storage conveyor 300 extends between the trailer station and the second floor of the warehouse 600. The storage conveyor 300 lets the containers 10 to move from the trailer station into the warehouse 600. Of course, this conveyor 300 moves the container 10 from the warehouse 600 to the trailer station.

The warehouse 600 is a high-storied building which is divided into two parts, that is, the inland base building and the wharf base building. The inland base building of the warehouse 600 has the plurality of storage cells 610 and the cart passages 640 provided between the storage cells 610. The carts 400 are installed in the cart passages 640 and horizontally move in the passages 640.

The wharf base building of the warehouse 600 is provided with at least one lift well 630 for receiving the lift 500 and letting the lift 500 vertically move therein.

In building the wharf base building of the warehouse 600, it should be considered that the container 10 passing through the second floor of the inland base building of the warehouse 600 from the storage rotary crane 200 through the storage conveyor 300, the cart 400 and another conveyor 300 is turned over to the lift 500 of the wharf base building of the warehouse 600. In the same manner as described for the inland base building, the wharf base building has the plurality of storage cells 610 and the cart passages 640 provided between the storage cells 610. The cart 400 equipped in its passage 640 horizontally moves in the passage 640 and turns over the container 10 to the lift 500. The shipping conveyor 300 extends between the wharf base building and the shipping yard and conveys the container 10 from the wharf base building to the shipping yard. Of course, the shipping conveyor 300 also conveys the container 10 from the shipping yard to the wharf base building. On the shipping yard, the shipping rotary crane 200 having the same structure as that of the storage rotary crane 200 is

placed.

In the wharfage system of the present invention, each of the shipping carts 700, 700A and 700' the conveyors 300, the carts 400 and the lifts 500 has two type of rollers, that is, the inside rollers and the coil spring-biased rollers, for accommodating all of the containers, that is, the conventional containers and the new containers 10 having the guide grooves 12 of this invention. When the new containers 10 shown in Fig. 12 will be exclusively used in the wharfage system of this invention, only the inside rollers are used with no addition of the spring-biased rollers. In this case, the spring-biased rollers may be removed from the system.

Hereinbelow, the operation of the automatic wharfage system of this invention will be described.

A locomotive (not shown) trailing the rail trailers 100 loaded with the containers 10 reaches the trailer station and, thereafter, is separated from its trailers 100. After the separation of the locomotive from the trailers 100, the trailer moving unit 150 of the trailer station moves each trailer 100 by a predetermined distance so as to make the trailer 100 precisely centered to the storage rotary crane 200. The operation of the trailer moving unit 150 will be described in conjunction with Figs. 2I to 2L. In the trailer moving operation, the power connection means 159 of the unit 150 is engaged with the trolley wire 158 of the pit 100P, thus to supply the electric power for the unit 150. In a high speed moving operation of the unit 150, the hydraulic cylinder C is driven so as to lift up the chain case frame 153 and to release the chain 153c from the rack 151a of the rail 151. Thereafter, the drive motor 152M starts its rotation, thus to rotate the roller shaft 152S which cooperates with the motor 152M through both the chain 152c and the sprocket 152s. As a result of rotation of the roller shaft 152S, the rollers 152R coupled to opposed ends of the roller shaft 152S roll on and move along their rails 151 at a desired high speed.

The above high speed movement of the trailer moving unit 150 is mainly carried out when the moving unit 150 loaded with no trailer needs to be moved.

In a precise movement of the moving units 150 along with the trailer 100, the hydraulic cylinder 153C returns to its initial position so as to cause the chain 153c, which chain 153c is wrapped about the sprockets 153s in the chain case frame 153, to be engaged with the rack 151a of the rail 151 through the recess 153b. In this state, the moving unit 150 along with the trailer 100 is precisely moved by the rotational force of the motor 153M.

In order to move the first rail trailer 100 for centering it to the storage rotary crane 200 or in order to move the container 10 on the support plate 110 of another trailer 100 for centering it to the storage rotary crane 200, the rail trailer 100 should be coupled to the trailer moving unit 150. In order to couple the trailer 100 to the moving unit 150, the actuating rod 152R' of the hydraulic cylinder 152C extends upward under the state that the center of the moving unit 150 is positioned between the centers of the wheel shafts of the trailer 100. Thus, the guide column 155 received in the rectangular column 154 is lifted up and, at the same time, the guide frame 157 protrudes out of the guide frame 156. The rollers 157R of the guide frame 157 thus contact with the wheel shaft 100S of the trailer 100. Therefore, the trailer 100 is coupled to the moving unit 150.

Since the wharfage system of the present invention is provided with the trailer moving unit 150, the trailer 100 in the trailer station can be moved without addition of the locomotive.

At this time, the power plug 156a provided at the center of the guide frame 156 is coupled to the power supply outlets 140 under the support plate 110 of the trailer 100, thus to supply the electric power for the electric elements, such as the locking unit, the guiders and the sensors of the trailer 100.

On the other hand, the rail trailer 100 has the container guiders 130, the locking units 120 and the power supply outlets 140 as shown in Figs. 2A to 2H. Here, container guiders 130 let the container 10 be stably seated on the support plate 110 of the trailer 100. The operation of the power supply outlet 140 of the trailer 100 will be described in conjunction with Figs. 2B to 2D. As shown in these drawings, the power plug 156a of the guide frame 156 is engaged with the power supply outlet 140 when the movable guide column 155 of the trailer moving unit 150 is lifted up. The guide panel 142 thus compresses its torsion spring 141 and is received in the cap housing 143, thus to guide the power plug 156a in the cap housing 143. The terminals of the power plug 156a of the guide frame 156 are tightly inserted into corresponding terminals 144a of the power outlet body 144 when the power plug 156a is more inserted into the cap housing 143. In this state, the power supply outlet 140 supplies the electric power for the power plug 156a.

When the power plug 156a of the guide frame 156 comes out of the cap housing 143, the guide panels 142 return from the folded positions to the extending positions by the elastic force of the torsion springs 141 as shown at the arrow of Fig. 2D. In this extending positions, the guide panels 142 prevent the foreign substances such as dirt from introduction into the cap housing 143, thus to keep the inside of the cap housing 143 cleaned.

The power outlet body 144 of the power supply outlet 140 is provided with the coil springs 145a mounted on the opposed guide rods 145. The coil springs 145a absorb the vertical shock and the vertical vibration generated in insertion of the power plug 156a into the cap housing 143. In addition, the horizontal shock and the horizontal vibration are absorbed by the horizontal springs 147a mounted on the guide rod 147 of the guide bracket 148.

The movable container guider 130 of the support plate 110 of the trailer 100 is guide means for guiding the

container 10 when the container 10 is loaded on the support plate 110 of the trailer 100. This guider 130 is preferably used when the container 10 delivered from the warehouse 600 is loaded on the support plate 110 by the storage rotary crane 200. As shown in Figs. 2A and 2H, the movable guider 130 is driven by the motor 130M and positioned about the guide hole 111 of the support plate 110. In order to guide the container 10 on the support plate 110, the guide panel 131 of the guider 130 is erected by the motor 130M, thus to let the container 10 be placed on its precise position on the support plate 110. When there is no container 10 on the support plate 110, the motor 130M is rotated in reverse direction, thus to rotate the guide panel 131 in the reverse direction and to make this panel 131 disappearing under the support plate 110.

The locking unit 120 of the support plate 110 is adapted for locking the container 10 onto the support plate 110 and for preventing a sudden separation of the container 10 from the trailer 100 caused by jolting of the trailer 100 during its transportation. The container locking operation of the locking unit 120 will be shown in Figs. 2A and 2E to 2G. The locking unit 120 positioned at the solid line of Fig. 2E is in a release position. In this release position, the container 10 may be lifted up from the support plate 110 by the rotary crane 200.

In order to lock the container 10 onto the support plate 110 of the trailer 100, the hydraulic cylinder $120C_2$ pulls its actuating rod under the condition that the pin head 121 is seated in the guide hole 111 of the support plate 110 as shown at the solid line of Fig. 2E. In this state, the pin head 121 can be inserted into the hole 11 of the container 10. The seesaw lever 126 is thus turned about the hinged point, thus to push up the upper nut 127 of the pin shaft 122 and to make this pin shaft 122 or the pin head 121 lifted up and received in the hole 11 of the container 10. In this state, the actuating rod $120R_1$ of the hydraulic cylinder $120C_1$ extends and causes the rotary lever 125 to be

guided by the rounded guide surface 123a of the case bracket 123. The rotary lever 125 is coupled to the rectangular cross-sectioned portion 122a of the pin shaft 122, so that the lever 125 rotates the pin shaft 122 at about 90° angle.

When the pin shaft 122 or the pin head 121 is rotated at about 90° angle, the pin head 121 is tightly engaged with the hole 11 of the container and, as a result, achieves a desired container locking state as shown at the dotted line of Fig. 2E.

Both the locking units 120 and the container guiders 130 of the support plate 110 are supplied with the electric power from the trailer moving unit 150.

As shown in Fig. 2A, the locking units 120 and the container guiders 130 are preferably arranged on the support plate 110 of the trailer 100 so as to seat all sizes of containers 10 thereon.

On the other hand, the rotary crane 200 may reach the trailer station while being loaded on the tractor trailer 100A shown in Figs. 3A to 3C. In order to center the tractor trailer 100A to the rotary crane 200, the trailer 100A is driven so as to be seated on the pallet 166 of the pallet unit 160. Thereafter, the reciprocating cylinder 162C moves leftward or rightward until the trailer 100A is centered to the crane 200. As a result of leftward or rightward movement of the reciprocating cylinder 162C, the pallet 166 fixed to the support frame 163 by the frame 162a of the cylinder 162C moves leftward or rightward with the trailer 100A loaded thereon.

The load applied to the pallet 166 is supported and slidably guided by the rollers 165R of the bearings 165.

As shown in Figs. 3A and 3B, the protruding pallet portions 167 of the pallet 166 are stably guided by the guide slits 168a of the guiders 168 such that they are scarcely horizontally played. The pallet 166 loaded with the trailer 100A is thus slidably guided and supported by the rollers 168R and precisely centered to the rotary crane 200.

The centering operation for the trailer 100 or 100A with respect to the storage rotary crane 200 will be conventionally carried out under the control of positional sensors or an electronic control unit.

The support plate (not shown) of the tractor trailer 100A has the same locking units 120 and the same container guiders 130 as described for the rail trailer 100. The arrangement and the operations of the units 120 and 130 of the tractor trailer 100A are same as the rail trailer 100. Please note that the tractor trailer 100A is supplied with the electric power from a tractor (not shown).

After centering the container loaded on the trailer 100 or 100A to the rotary crane 200, the container 10 will be lifted up by the crane 200. The operation of the crane 200 is represented in Figs. 1C and 4A to 4H. As shown in these drawings, the rollers $230R_1$ of the first roller frames 230A driven by the rotational force of the motor $230M_1$ roll on the first running rails 220A, thus to longitudinally move the crane 200.

The crane 200 stops its longitudinal movement at the lengthwise center of the container 10 loaded on the trailer 100 or 100A placed on the first floor. Thereafter, the rollers $230R_2$ of the second roller frame 230B are driven by the rotational force of the motor $230M_2$ and roll on the second running rails 220B. This transverse movement of the crane 200 may be carried out at the same time of the longitudinal movement of the crane 200. The crane 200 stops its transverse movement at the width center of the container 10. Therefore, the centering operation of the crane 200 with respect to the container 10 is achieved.

Thereafter, the actuating rod 232R of the hydraulic cylinder 232C of the upper body 232 of the crane 200 is retracted and this makes the sheaves 233C of the rod 232R guided along the guide rails 234.

Hence, the wire rope W is unwound so as to down the lower body 240 of the crane 200 and this causes the container grip unit 260 coupled to the shaft 250S of the

rotary unit 250 to be downed.

Of course, the sprocket 240s is rotated by the motor 240m and drives the chain 252c of the annular frame 252 before the lower body 240 is downed. Hence, the annular frame 252 is rotated and achieves a desired centering operation of the crane 200 with respect to X- and Y-directional centers of the container 10.

At this time, the rollers 255R support the load applied on the annular frame 252 and makes this frame 252 guided smoothly.

Here, it is preferred to carry out the longitudinal and transverse movements of the upper and lower bodies 230 and 240 and the rotation of the annular frame 252 at the same time.

In addition, the lowering motion of the upper and lower bodies 230 and 240 is carried out nearly at the same time of the longitudinal and transverse movements of the upper and lower bodies 230 and 240 and the rotation of the annular frame 252. In this case, all the aforementioned motions, that is, the longitudinal and transverse movements of the upper and lower bodies 230 and 240, the rotating motion of the annular frame 252 and the lowering motion of the upper and lower bodies 230 and 240, will be carried out nearly at the same time until the slant panels 264 provided on the bottom surface of the rectangular frame 261 are positioned just above the uppermost end of the container 10.

In this regard, the rotary crane 200 of this invention moves its container grip unit 260 to a desired position through a shortest passage and in a shortest time.

After centering of the crane 200 with respect to the container 10, the actuating rod 232R of the hydraulic cylinder 232C is fully retracted, thus to guide the container 10 to the slant panel 264 of the rectangular frame 261 and to cause this container 10 to be stably seated on the panel 264.

Thereafter, the pin 263 protrudes out of the frame 261 by the hydraulic cylinder 263C of the frame 261 and is

inserted into and locked to the hole 11 of the corner of the container 10.

The rectangular frame 261 further includes the variable guiders 270 for lengthwise guiding the varieties of containers 10. The variable guider 270 normally folds its guider 271 hinged to the support bracket 273 in accordance with extension of the actuating rod 270R of the hydraulic cylinder 270C. However, when the actuating rod 270R of the cylinder 270C is retracted, the guider 270 lengthwise guides the container 10 as shown in Figs. 4E and 4F.

At this time, the stepped section 272 of the guider 271 normally stops the container 10 in the vertical direction.

When the crane 200 appropriately guides and precisely locates the container 10 in accordance with a size of container 10 and locks the container by the lock pins 263, the actuating rod 232R of the hydraulic cylinder 232C extends, thus to make the sheaves 233C guided along the angle rails 234 and to pull upward the wire rope W wrapped about the sheaves 233C. Hence, the container 10 is lifted up from the trailer 100 or 100A. In other words, the container 10 is lifted up from the first floor to the second floor. In this container lifting state, the rollers $230R_1$ are driven by the rotational force of the motor $230M_1$ of the crane 200 and makes the crane 200 longitudinally running along the first running rails 220A onto the rectangular frame 320 of the conveyor 300. When the container 10 reached onto the rectangular frame 320 of the conveyor 300, the longitudinal movement of the crane 200 along the rails 220A is stopped. At this state, the container 10 is lowered onto and seated on the rectangular frame 320 of the conveyor 300 by retracting of the actuating rod 232R of the hydraulic cylinder 232C.

The storage conveyor 300 is provided with folding guiders 350 for guiding the container 10 and achieving the precise setting of the container 10. As shown in Fig. 5B, each guider 350 is hinged to the side surface of the rectangular cross-sectioned frame 320 and levered by a link

motion of a link 350L. The guiders 350 are erected by the link 350L in accordance with actuation of the hydraulic cylinder 350C. At this state, the step portion 350A of the guider 250 substantially meets with the angled corner of the rectangular cross-sectioned frame 320, thus to guide the container 10 to the desired position on the frame 320.

After setting the container 10 on the desired position of the frame 320, the pin 263 of the rotary crane 200 is opened outward and released from its locked state to the container 10 by the hydraulic cylinder 263C. In this state, the container grip unit 260 of the crane 200 is slightly lifted up or returned to its initial position wherein the unit 260 waits for the later lifting operation for another container 10. Thereafter, the conveyor 300 moves using its own force the container 10 into the inland base building of the warehouse 600. At this time, the guiders 350 are folded by retracting the actuating rod of the hydraulic cylinder 350C, thus to remain no hindrance to the movement of the container 10 on the conveyor 300.

During movement of the container along the conveyor 300, the container is placed on the spring-biased rollers 322 at its outside bottom surface. Particularly, the new container 10 of the present invention is seated on the inside rollers 321 of the conveyor 300 in such a manner that its guide grooves 12 are engaged with the inside rollers 321.

The shaft 330S is, thereafter, rotated by the rotational force of the motor 330M and this makes the sprocket 330s rotated. The rotating sprocket 330s drives the chain 330c in the recessed chain guide frame. At this time, the fingers 340 pushes the rear end of the container 10, so that the container 10 advances on the conveyor 300. When the container 10 passes through the inland base building of the warehouse 600, it is preferred to use the cart 400 as connection means between the conveyors 300. Use of the cart 400 as the connection means between the conveyors 300 saves the inside space of the warehouse 600.

In operation of the cart 400, the roller 410R of the cart 400 is driven by the rotational force of the motor 410M transmitted thereto through the shaft 410S, thus to move the cart 400 horizontally and to let the containers 10 be stored in or delivered from their storage cells 610 provided in the warehouse 600. At a position about the conveyor 300, the cart 400 stops its horizontal movement along the cart passage 640. At this state, the rectangular cross-sectioned frames 420 of the cart 400 should be aligned with the rectangular cross-sectioned frames 320 of the opposed conveyors 300. The lock pins 421a of the cart 400 are inserted into the rectangular cross-sectioned frames 320 of the opposed conveyors 300, thus to reliably continue the desired straightness of the container running passage irrespective of vibration and load.

Since the conveyor 300 can not move the container 10 at the outside of the operating range of the finger chain 330C, the rear end of the container 10 is not laid on the cart 400 but laid on the conveyor 300 when the container 10 is turned over from a conveyor 300 to another conveyor 300 through the cart 400.

Hence, when the reciprocating cylinder 440C of the cart 400 is moved rightward as shown in Fig. 6D, the opposed rollers 440R roll on the guide rails 441. Here, the reciprocating cylinder 440C is fixed to the chain guiders 432 through the support bracket 431, so that the reciprocation of the cylinder 440C lets the chain guiders 432 move in the same direction. At this time, the shoe angles 433 of the chain guiders 432 are guided by the guide rails 434. Thus, the chain guiders 432 protrude rightward as shown in Fig. 6A and advance into the conveyor 300.

Here, the width of the chain guiders 432 of the cart 400 should be different from that of the chain guiders 330 of the conveyor 300 in order to remove an interference between the chain guiders 432 and 330 in advancing of the chain guiders 432 into the chain guiders 330.

The chain 430c is driven by the sprocket 430s rotated

by the rotational force of the motor 430M in the state that the chain guider 432 of the cart 400 is exposed to the outside of the rear end of the container 10 which has not been turned over to the conveyor 300. When the chain 430c is driven, the regularly spaced fingers 430 of the chain 430c are guided by and moved along the recess 432a of the channel 432A while pushing the container 10 forward. Thus, the container 10 is moved along the rollers 422 and the inside rollers 421 of the rectangular cross-sectioned frames 420.

The pin drive units 450 of the rectangular cross-sectioned frames 420 are used for both delivery of the container 10 from the storage cell 610 and movement of the container 10. When the chain 450c is driven by the sprocket 450s rotated by the rotational force of the motor 450M, the pin drive units 450 are moved at the same time. However, when the positional sensing lever 456 comes into contact with the front end of the container 10, the angle base 457 compresses the spring 458a about the pin 457a and turns on the limit switch 459, thus to start the motor $455M_1$ and to protrude the pin 455. The protruding pin 455 is inserted into and locked to the hole 11 of the container 10.

During the movement of the container 10, the lever 456 closer to the moving direction of the container 10 is folded while the other lever 456 remains its extension state.

When the lever 456 is not used, it is driven by the rotational force of the motor $455M_2$ to be erected.

When the motor 450M is driven in a direction wherein the container 10 is delivered from the storage cell 610, the container 10 of the storage cell 610 is loaded on the cart 400.

At this time, the storage cell 610 is sloped downward from its input side to its rear side at the gradient of about 3/1200. With the gradient of the storage cell 610, the container 10 is not dropped from its storage cell 610 to the ground irrespective of vibration of the warehouse 600. The gradient also allows the container 10 to be precisely

stored in the cell 610 under the guide of the spring-biased rollers 612.

The container 10 slightly protrudes out of the storage cell 610 to the cart passage when the container 10 is stored in the storage cell 610 as shown in Fig. 13.

Meanwhile, the container 10 loaded on the cart 400 and moved by the cart fingers 430 is turned over to another conveyor 300 or to the lift 500. The operation of the lift 500 will be described hereinbelow in conjunction with Figs. 7A to 7F.

In the same manner as described for the cart 400, the reciprocating cylinder 540C is driven so as to move the chain guiders 532 which are fixed to the reciprocating cylinder 540C through the support bracket 531. In this state, the motor 530M starts and rotates the sprocket 530s, thus to drive the chain 530c wrapped about the sprocket 530s. Hence, the fingers 530 pushes the rear end of the container 10 forward. The container 10 may be moved by the pin drive unit shown in Figs. 8A and 8B.

The container 10 loaded on the lift 500 is slidably guided by the rollers 522 and the inside rollers 521 of the rectangular cross-sectioned frames 520 of the lift 500. When the container 10 is continuously moved forward, it passes through both the cart 400 and the lift 500 in order to be turned over to the shipping conveyor 300 extending to the shipping rotary crane 200.

Of course, the lift 500 loaded with the container 10 may be lifted up in the lift well 630 to a desired floor of the warehouse 600 by winding the rope. In this case, the rollers 510R of the lift 500 roll on and are guided by the guide rails 500R of the lift well 630. When the lift 500 reaches the desired floor of the warehouse 600, the container 10 is moved by the cart 400 in order to be stored in the desired storage cell 610.

The shipping rotary crane 200 has the same structure and carries out the same operation as that of the storage rotary crane 200. However, this shipping rotary crane 200

lifts up the container 10 on the shipping conveyor 300 and turns over the container 10 to the shipping cart 700, 700A or 700'. The container 10 is in turn loaded on the vessel 900 by the gantry crane 800.

The operation of the shipping cart will be described hereinbelow in conjunction with Figs. 9A to 9J. When the container 10 is seated on the panel 714 of the shipping cart 700 by the shipping rotary crane 200, the motor 740M starts and rotates the sprocket $740s_1$, thus to drive the chain 740c wrapped about the sprocket $740s_1$ and to rotate the shaft 740S. Because of rotation of the shaft 740S, the wheels 740W run along the rails $740R_1$ and let the container 10 to be precisely centered to the gantry crane 800. When the centering of the container 10 with respect to the gantry crane 800 is finished, the shipping cart 700 stops its movement. At this state, the container 10 is shipped on the vessel 900 by conventional shipping means of the gantry crane 800 (see Figs. 1A and 1B).

The power supply for the shipping cart 700 is achieved by connection of the trolley terminals 752b of the power input unit 750 to the trolley wire 751A of the pit 700P. In addition, the springs 753a placed in the slide member 753 of the box 752 absorb the vibration and mechanical shock generated in running motion of the shipping cart 700. The connection and separation of the power input unit 750 is carried out by the hydraulic cylinder 750C whose actuating rod 750r is fixed to the slide member 753.

After the container is lifted up from the shipping cart 700 by the gantry crane 800, the shipping cart 700 returns to its standby position for the later operation. In this case, the shipping cart 700 returns to its standby position with its body downed in the pit as shown at the dotted line of Fig. 9C in order to prevent interference with the other shipping carts.

In order to down the shipping cart 700 in the pit 700P, the motors 710M, which are mounted on the panel 714 for removing the load generated in retraction of the wheels 740W

on the rails $740R_1$, start so as to move the rollers 711 of their support arms 712 from the dotted line position to the solid line position of Fig. 9A. Thus, the rollers 711 come into contact with side walls of the pit 700P. More rotation of the motors 710M causes levering motion and slightly lifts up the shipping cart 700 in the direction shown at the arrow of Figs. 9A and 9D. In this regard, the wheels 740W are slightly suspended above the rails $740R_1$. At this state, the actuating rod 732R of the hydraulic cylinder 732C retracts and pulls the shaft loading plate 732b, thus achieve the desired power transmission due to the spline coupling of the shaft 740S.

Thereafter, the actuating rods 720R of the hydraulic cylinders 720C mounted on the bottom channel 732a extend so as to let the lower body of the cart 700 be downed due to its own weight to a position wherein the wheels 740W are placed just above the lower rails $740R_2$ as shown at the dotted line 9C. At this state, the panel 714 is still supported by the support arms 712. Thereafter, the hydraulic cylinders 732C return the wheels 740W to their initial positions and these wheels 740W are seated on the rails $740R_2$ by the operation of the hydraulic cylinders 720C. In this state, the actuating rod 750r of the hydraulic cylinder 750C of the power input unit 750 mounted on the bracket 732 at the inside of the wheels 740W extends so as to make the trolley terminals 752b of the box 752 connected to the lower trolley wire 751B of the pit 700P.

The motor 710M, thereafter, starts its reverse rotation so as to fold the support arm 712 and to return this arm 712 to its initial state. In this state, the actuating rod 750r of the cylinder 750C of the power input unit 750 is retracted, thus to separate the trolley terminals 752b from the trolley wire 751B and to turn off the power supply. The panel 714 is, thereafter, lowered in the pit 700P by retracting the actuating rod 720R of the hydraulic cylinder 720C, thus to place the shipping cart 700 on the lower rails $740R_2$.

The motor 740 is rotated in the reverse direction and rotates the wheel shaft 740S which cooperates with the motor 740 through the sprocket $740s_1$ and the chain 740c. The wheels 740W run along the lower rails $740R_2$ at the lower section of the pit 700P and are lifted up when it reaches a desired position. This cart lifting operation is reverse to the aforementioned cart lowering operation.

When the panel 714 is separated from and coupled to the lower body of the cart 700, the wheel shaft 740S is guided by the guide recess 723 of the guide plate 723. The plate spring 731 is supported on the bracket 732 at its bottom center and mounted on the spring seat 721a of the frame 720.

The shipping cart 700' of Figs. 10A to 10F according to the another embodiment of the present invention is used, for example, when the containers 10 are loaded on the vessel 900 without addition of the gantry crane 800. Alternatively, the shipping cart 700' may be used when the container 10 is directly conveyed without using the system of this invention or conveyed from the inland base building to the wharf base building of the warehouse 600. The operation of the shipping cart 700' will be descried hereinbelow. Most of the operation of the suspended shipping cart 700' is similar to that of the above shipping cart 700. However, in lowering and ascending of the shipping cart 700', the rails $740R_1$' instead of the wheels 740W' extend and retract differently from the shipping cart 700. When there is a slope on the shipping cart 700', the chain 790c is installed such that it is wrapped about the sprockets 790 of the wheel shaft 740W'.

In the suspended shipping cart 700', the power connection for the shipping cart 700' is achieved by simple lowering of the lower body of the cart 700', so that this shipping cart 700' has no power input unit differently from the shipping cart 700.

The shipping cart 700A of Figs. 11A and 11B according to the still another embodiment of the present invention is exclusively used for the new container 10 shown in Fig. 12.

The construction of this shipping cart 700A is not complex but simple differently from the shipping cart 700. In operation of the shipping cart 700A, the rollers 760R mounted on opposed ends of each of the regularly spaced shafts 760S are driven by its motor 760M and move the container 10 supported thereon. These rollers 760R are stably seated in the lengthwise guide grooves 12 formed on the bottom of the container 10. The motors 760M of the shafts 760R sequentially start in the relay type under the control of the positional sensors 761, thus to advance the container 10.

At this time, the guiders 760G erected by their hydraulic cylinders 760C guide the corners of the container 10 which is loaded on the cart 700' by the shipping rotary crane 200.

Of course, the guiders 760G are opened outward by retracting the actuating rods of the hydraulic cylinders 760C when the container 10 needs moving. Hence, there is no hindrance during movement of the container 10 by the cart 700A.

The gantry crane 800 is supported by the columns installed about the shipping cart. The width between the columns of the gantry crane 800 is wider than that of the shipping cart, so that the gantry crane 800 moves transversely within a predetermined moving range. In order to prevent the interference between the lengthwise movement of the shipping rotary crane 200 along the first running rails 220A and the transverse movement of the gantry crane 800 along the transverse rails 810, the actuating rods 282 of the cylinders 283 are retracted so as to lift up their running rails 220A toward the warehouse 600 when the gantry crane 800 should pass across the first running rails 220A. After passing of the gantry crane 800, the actuating rods 282 extend so as to return the rails 220A to their horizontal positions and to allow the lengthwise movement of the shipping rotary crane 200 along the first running rails 220A.

In the above description for the automatic wharfage system according to the present invention, the structures and the operations of the elements, which will be easily understood and modified by those skilled in the art, have not been described in detail.

The above automatic wharfage system can be automatically controlled by a computer system, so that it achieves an unmanned automation of the wharfage system. The warehouse of the system comprises two high-storied buildings whose container storage capacity is scarcely limited, so that the system of this invention saves the wharfage space. In addition, the loading and unloading of the containers are easily fast carried out by the system.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. An automatic wharfage system for storage, loading and unloading a cargo container comprising:

a high-storied warehouse comprising an inland base building and a wharf base building standing close by and communicating with each other, each base building having a plurality of container storage cells, a storage cart horizontally moving a container at each story of the base building and storing the container in a desired storage cell, and a lift for lifting up the container to a desired story of the base building;

a trailer station placed at a side of said inland base building and accommodating a container trailer;

a plurality of shipping carts placed at a side of said wharf base building, each shipping cart being movable in parallel with the wharf base building for moving the container to a gantry crane; a first conveyor extending from said trailer station to a second floor of the inland base building for moving the container from the trailer station to the inland base building;

a second conveyor extending from a first floor of said wharf base building to the shipping carts for moving the container from the wharf base building to the shipping carts;

a first rotary crane placed above the trailer station and running along a pair of longitudinal running rails in parallel with the trailer station for delivering the container of the container trailer to the first conveyor;

a second rotary crane placed above the second conveyor and running along a pair of longitudinal running rails in parallel with the second container conveyor for delivering the container of the second conveyor to one of the shipping carts; and

a gantry crane for loading and unloading the container on and from a vessel.

2. The automatic wharfage system according to claim 1, wherein said container trailer is a rail trailer moved by a trailer moving unit provided in a pit of said trailer station, said rail trailer comprising:

a container support plate;

a plurality of locking units provided on a bottom surface of said support plate, each locking unit being locked to a locking hole of a corner of said container;

a movable guider provided at a side of each locking unit for guiding a corresponding corner of said container, said movable guider appearing and disappearing through a cutout portion of the container support plate;

two pairs of front wheels and two pairs of rear wheels, said wheels being provided under the container support plate and rotatably supported by their wheel shafts; and

a pair of power supply outlets provided between said pairs of front wheels and between said pairs of rear wheels respectively.

3. The automatic wharfage system according to claim 2, wherein each of said locking units comprises:

a case bracket having a fixing channel, said bracket being mounted on the bottom surface of said container support plate;

a locking pin vertically movably received in said case bracket, said locking pin being received in a guide hole of said container support plate at its pin head so as to be locked to the locking hole of the container, a pin shaft of said locking pin having a rectangular sectioned middle portion;

a first hydraulic cylinder hinged to said fixing channel of the case bracket;

a rotary lever for rotating said locking pin, one end of said rotary lever being hinged to an actuating rod of the first hydraulic cylinder, a middle section of said rotary lever being fitted over the rectangular sectioned middle portion of the pin shaft, the other end of said rotary lever

coming into movable contact with and slidably moving on a rounded guide surface of said case bracket;

a second hydraulic cylinder hinged to an upper side of said case bracket such that it is suspended;

a seesaw lever having a ball-shaped middle section for vertically reciprocating said locking pin, said middle section being fitted over said pin shaft at a position under said rotary lever, one end of said seesaw lever being hinged to an actuating rod of the second hydraulic cylinder, the other end of said seesaw lever being hinged to said case bracket; and

a pair of nuts fitted over said pin shaft on and under the ball-shaped middle section of the seesaw lever respectively, said nuts vertically reciprocating said locking pin in accordance with a levering motion of said seesaw lever.

4. The automatic wharfage system according to claim 2, wherein said movable guider is positioned about said guide hole of the container support plate and comprises:

a guide panel horizontally connected at its bottom side to a reversible motor, said motor being fixed to the bottom surface of said container support plate, said guide panel appearing and disappearing through said cutout portion of the container support plate in accordance with rotation of said reversible motor.

5. The automatic wharfage system according to claim 2, wherein each of said power supply outlets comprises:

a rectangular cap housing provided under said container support plate;

a pair of vertical guide rods fixed to an upper inside surface of said cap housing;

a plurality of guide panels hinged to lower end of said cap housing and biased by their torsion springs;

a power outlet body having a plurality of terminals at its bottom surface, said outlet body being movably fitted

over said vertical guide rods and biased by coil springs received on said vertical guide rods;

a pair of rectangular sectioned vertical columns vertically fixed to the bottom surface of the container support plate at their top ends and slidably coupled to a top surface of said cap housing at their lower ends such that they slide leftward and rightward on the cap housing;

a guide bracket mounted on said cap housing between said vertical columns; and

a pair of horizontal guide rods crossing each other, said horizontal guide rods being horizontally fixed to said guide bracket and biased by their springs.

6. The automatic wharfage system according to claim 2, wherein said trailer moving unit comprises:

a pair of I-beam rails lengthwise laid on the bottom of said pit, each rail having a rack on its top surface;

front and rear pairs of rollers rotatably mounted on front and rear sections of a pair of connector bodies by front and rear shafts, said rollers rolling on said I-beam rails;

said connector bodies including their respective bushes for supporting said front and rear shafts, said connector bodies having opposed channels, said channels being connected at their bottom sections to each other by a connection plate;

a sprocket mounted on one of said front and rear shafts, said sprocket cooperating with a first motor through a chain;

a first hydraulic cylinder vertically provided on a top center of said connector body, an actuating rod of said first hydraulic cylinder being fixed to a longitudinal beam;

a pair of chain case frames fixed to opposed ends of said longitudinal beam, each chain case frame having a rack guide recess at its bottom and provided with both main sprockets and subsidiary sprockets;

a second motor placed between said chain case frames,

said second motor having opposed output shafts coupled to their corresponding main sprockets for driving these sprockets;

a rectangular column including a second hydraulic cylinder, said rectangular column being vertically fixed to the center of said connector bodies;

said second hydraulic cylinder, an actuating rod of this second cylinder being connected to a vertically movable guide column movably received in said rectangular column;

a guide frame including a third hydraulic cylinder, said guide frame being fixed at the top center of said guide column;

guide frames hinged to opposed actuating rods of said third hydraulic cylinder, each guide frame having two pairs of rollers;

a power plug provided on the center of each guide frame, said power plug being engaged with the power supply outlet of the container support plate; and

power connection means connected to trolley wires of said pit for supplying electric power for said trailer moving unit.

7. The automatic wharfage system according to claim 1, wherein said container trailer is a tractor trailer comprising:

a container support plate;

a plurality of locking units provided on a bottom surface of said container support plate, each locking unit being locked to a locking hole formed on a corner of said container;

a movable guider provided at a side of each locking unit for guiding a corresponding corner of said container, said movable guider appearing and disappearing through a cutout portion of the container support plate;

a pair of opposed rod frames fixedly placed on a bottom center of a pit;

a pair of actuating rods extending in parallel between

said rod frames and penetrating a reciprocating cylinder so as to cooperate with this cylinder;

a pair of horizontal frames extending outward from opposed sides of said reciprocating cylinder, said horizontal frames being fixed to two pairs of I-beam support frames;

said I-beam support frames axially placed on opposed top sides of said horizontal frames for supporting opposed sides of a pallet;

a pair of channel support members axially placed on the bottom of said pit at opposed sides of said reciprocating cylinder, said channel support members supporting their bearings;

a roller coupled to each of said bearings and guided between said support frames;

a plurality of protruding pallet portions provided on front and rear opposed sides of said pallet, said pallet portions being received in their guide slits; and

a pallet portion guider having a plurality of rollers for supporting and guiding said pallet portions, said guider being placed under said pallet.

8. The automatic wharfage system according to claim 1, wherein each of said first and second rotary cranes comprises:

an upper body comprising:

a pair of roller frames connected to each other by a pair of spaced connection beams, said roller frames including rollers at their opposed ends, said rollers rolling on a pair of first running rails;

roller shafts extending between said rollers, each roller shaft having a drive motor at its center and transmitting the rotational force of said motor to the rollers, thus to rotate these rollers;

a support plate having a wire hole and fixed to one of said connection beams, said support plate having a first hydraulic cylinder;

a pair of first sheaves mounted on an actuating rod of the first hydraulic cylinder by a sheave shaft, said sheave shaft being guided and supported by a pair of T-shaped rails;

said T-shaped rails fixed on a subsidiary support member by a support channel; and

a pair of second sheaves mounted on a bracket by a shaft at the back of said support plate;

a lower body comprising:

a first rectangular frame comprising a pair of longitudinal frames and a pair of transverse frames, said first rectangular frame having third sheaves under outside sheaves of the upper body; and

bushes having their bearings at their centers, said bushes being placed at the center of said lower body;

a wire extending from said support plate of the upper body to a bottom surface of the support plate through inside sheaves of the upper body, said outside sheaves of the upper body and said third sheaves of the lower body;

a container grip unit rotated by said lower body and coupled to a rotary unit shaft, said grip unit including longitudinal frames and transverse frames, said longitudinal and transverse frames being fixed to and heaped on the center of an elongated second rectangular frame and fixed to said rotary unit shaft;

said rotary unit having a plurality of downward inclining frames mounted on said rotary unit shaft, said inclining frames being fixed to a predetermined diameter annular frame;

a concentrical disc mounted on said rotary unit shaft for fixing inside ends of a plurality of radial support frames thereto;

said radial support frames fixed to said annular frame at their outside ends;

a chain wrapped about and extending between said annular frame and a sprocket, said sprocket being rotated by the rotational force of a motor mounted on a side of said

lower body;

a plurality of rollers rotatably supported by their support brackets, said brackets being placed under said annular frame; and

said second rectangular frame horizontally suspended by a plurality of tensile rods extending between said rotary unit shaft and four corners of said second rectangular frame, each tensile rod being adjusted in its tensile force by a turn buckle, said second rectangular frame comprising:

a second hydraulic cylinder placed in said second rectangular frame, said second hydraulic cylinder having a locking pin detachably locked to a locking hole of said container;

a plurality of slant panels provided on a bottom surface of said second rectangular frame for guiding a 40 ft. sized container; and

a pair of variable guiders for centering varieties of containers.

9. The automatic wharfage system according to claim 8, wherein each of said variable guiders comprises:

a fourth hydraulic cylinder hinged to said second rectangular frame; and

a guider hinged to an actuating rod of said fourth hydraulic cylinder and coupled to a support bracket of said second rectangular frame by a pin, said guider including a stepped section and an inclined section extending from said stepped section.

10. The automatic wharfage system according to claim 1, wherein said first conveyor comprises:

a pair of rectangular sectioned frames laid in parallel on a lattice frame;

a plurality of inside rollers rotatably mounted on an inside surface of each said rectangular sectioned frame and spaced out at regular intervals;

a plurality of spring-biased rollers rotatably mounted

on each said rectangular sectioned frame such that they are spaced out at regular intervals, said spring-biased rollers being biased by their springs at their lower ends;

a pair of chain guide frame placed at the inside of said inside rollers such that they are spaced apart from their corresponding rollers by a predetermined distance, each of said chain guide frames having a finger guide recess thereon and a chain therein;

said chain wrapped about a sprocket and driven by a motor; and

a plurality of regularly spaced fingers provided on said chain.

11. The automatic wharfage system according to claim 10, wherein said first conveyor further comprises:

folding guiders for guiding said container and precisely setting said container on said first conveyor, each of said guiders being hinged to a side surface of the rectangular sectioned frame and levered by a link motion of a link and having a step portion for substantially meeting with an angled corner of said rectangular sectioned frame, said link being hinged to an actuating rod of a hydraulic cylinder fixed to a bottom surface of said rectangular sectioned frame.

12. The automatic wharfage system according to claim 1, wherein said storage cart of the warehouse comprises:

a rectangular frame having transverse running rollers at its four corners, one of said rollers being coupled to a roller shaft and driven by a first drive motor for making said rectangular frame running transversely on a pair of spaced cart rails;

a pair of first chains lengthwise extending in said rectangular frame and wrapped about opposed first sprockets, each first chain having a locking pin drive unit and guided by a first chain guider fixed to a first support bracket;

a second drive motor coupled to said opposed first

sprockets through its opposed output shafts, thus to drive said sprockets;

a pair of rectangular sectioned frames fixed to a pair of support frames of said rectangular frame at their opposed ends and providing a passage for the container, each of said rectangular sectioned frames being spaced apart from a corresponding first chain guider by a predetermined distance;

a plurality of regularly spaced inside rollers mounted on inside surfaces of said rectangular sectioned frames for supporting said container thereon;

a plurality of spring-biased rollers rotatably mounted on each of said rectangular sectioned frames;

locking pins provided on opposed ends of each of said rectangular sectioned frames, thus to reliably continue desired straightness of the container running passage, said locking pins being driven by their hydraulic cylinders;

a second chain wrapped about a second sprocket and lengthwise driven by a third drive motor under the guide of a second chain guider, said second chain having a pair of opposed fingers;

said second chain guider fixed to a second support bracket, said second chain guider having an elongated upper channel and a pair of lower channels, said upper channel having a finger guide recess thereon, said lower channels being formed under said upper channels and forming a box-shape line;

a pair of shoe angles provided in said second chain guider, said shoe angles being mounted on their guide rails and fixed to said second support bracket; and

a reciprocating cylinder having opposed rollers and fixed to said second support bracket, said rollers of the reciprocating cylinder moving on parallel guide rails mounted on the support frames of the rectangular frame, said guide rails being fixed to a pair of rod frames at its front and rear ends respectively.

13. The automatic wharfage system according to claim 1, wherein said lift of the warehouse comprises:

a rectangular frame having therein a pair of first chains lengthwise placed;

each of said first chains having a locking pin drive unit, said first chain being wrapped about a first sprocket driven by a first drive motor;

a first support bracket and a first chain guider for supporting said lift and guiding said first chain respectively;

a base fixed to a bottom of said first chain guider and guided by a guide rail between said rectangular frame and a pair of rectangular sectioned frames, said base having not only a rack portion on its bottom surface but also protrusions on its opposed sides;

a gear for driving said base so as to make it appearing and disappearing, said gear being coupled to a shaft of a second drive motor, said second motor being mounted on a transverse frame of said rectangular frame;

said rectangular sectioned frames provided at the inside of said first chain guiders, opposed ends of said rectangular sectioned frames being fixed to a pair of support frames of said rectangular frame, thus to provide a passage for said container;

a plurality of inside rollers rotatably mounted on inside surfaces of said rectangular sectioned frames and supporting said container thereon;

a plurality of spring-biased rollers rotatably mounted on each of said rectangular sectioned frame such that they are spaced out at regular intervals;

a second chain wrapped about a second sprocket and driven by a third drive motor under the guide of a second chain guider, said second chain having a pair of opposed fingers;

said second chain guider fixed to a second support bracket, said second chain guider having an elongated upper channel and a pair of lower channels, said upper channel

having a finger guide recess thereon, said lower channels being formed under said upper channels and forming a box-shape line;

a reciprocating cylinder having opposed rollers and fixed to said second support bracket, said rollers of the reciprocating cylinder moving on parallel guide rails mounted on the support frames of the rectangular frame, said guide rails being fixed to a pair of rod frames at its front and rear ends respectively;

a plurality of guide rollers provided at four corners of said rectangular frame, said guide rollers rolling on their rails of a lift well of the warehouse during a vertical movement of said lift;

four columns vertically provided on said rectangular frame and connected to each other by horizontal beams at their uppermost ends so as to form a framework;

a wire rope coupled to every top corner of said framework, said wire rope being wrapped about and driven by a winch installed in a penthouse of the warehouse; and

at least one weight for balancing said lift, said weight being guided by its guide rail.

14. The automatic wharfage system according to claim 12 or 13, wherein said pin drive unit comprises:

a base plate having a pair of rollers on its opposed bottom surfaces, said base plate being coupled to the first chains at its front and rear ends and guided by the first chain guiders;

a pin connected to a fourth drive motor through worm and worm gear mechanism, said pin appearing and disappearing in accordance with rotation of said fourth motor;

a positional sensing lever for sensing a position of an angle base, said sensing lever being biased by a torsion spring and driven by a fifth drive motor, said fifth motor being fixed to said angle base;

said angle base cooperating with a limit switch, said angle base being pinned such that it is rotated in

accordance with sensing result of said positional sensing lever;

a shock absorbing spring provided on said angle base; and

a stopper for limiting a moving range of said angle base, said stopper being placed about an end of said angle base.

15. The automatic wharfage system according to claim 1, wherein each of said shipping carts comprises:

a cart frame seated on a pit, said cart frame having two pairs of longitudinal beams, a plurality of regularly spaced transverse beams and rollers at its four corners, said rollers being supported by their support arms and seated on edge of said pit and driven by a first drive motor;

buffer means provided on front and rear centers of said cart frame for absorbing mechanical shock generated when said shipping cart collides on another shipping cart;

plate springs provided under front and rear sections of said longitudinal beams, said plate springs being supported by their brackets at their centers and seated on spring seats of said cart frame at their opposed ends;

a plurality of front and rear wheels rotatably provided on opposed sides of front and rear sections of said brackets by their spline shafts;

a power input unit provided on at least one side of said brackets;

each said wheel shaft vertically guided in a guide recess of a guide plate, said guide plate extending downward from each said longitudinal beam of the cart frame;

a plurality of first hydraulic cylinders fixed to said brackets such that they extend outward, an actuating rod of each said first hydraulic cylinder fixing a shaft loading plate to a corresponding wheel shaft and causing this loading plate to cooperate with said wheel shaft, thus to allow a corresponding wheel to appear and disappear horizontally;

two-stage hydraulic cylinders for lifting up said cart frame, said two-stage hydraulic cylinders being vertically provided on bottom channels and having their actuating rods fixed to said transverse beams, said bottom channels extending between said brackets;

chain sprockets provided on middle portions of either of the front and rear wheel shafts;

a middle sprocket driven by a second drive motor and cooperating with said chain sprockets, said middle sprocket rotating said chain sprockets and driving said front or rear spline shafts and making said wheels running along upper or lower running rail, said upper and lower running rails being projected from opposed side walls of said pit and vertically spaced apart from each other.

16. The automatic wharfage system according to claim 1, wherein each of said shipping carts comprises:

a pair of rectangular sectioned frames placed in parallel, said frames having a plurality of opposed rollers, each pair of opposed rollers being coupled to each other by a roller shaft and engaged with their guide grooves of a container bottom surface, one of said rollers being driven by a drive motor;

a plurality of positional sensors provided between the roller shafts, said sensors starting said shipping cart when said container reached the cart but stopping said shipping cart when said container is removed from the cart; and

a container guider for guiding said container onto said rectangular sectioned frames, said guider having a stepped portion at its lower section and being driven by both a second hydraulic cylinder and a link.

17. The automatic wharfage system according to claim 1, wherein each of said shipping carts comprises:

several pairs of opposed support columns vertically placed on a container running passage and spaced out at regular intervals;

upper and lower beams horizontally extending between said support columns;

upper and lower running rails laid on said upper and lower beams respectively;

a plurality of first hydraulic cylinders horizontally fixed to the support columns, actuating rods of said first cylinders being coupled to said upper rails so as to linearly reciprocating the rails for adjusting a width between the rails;

a cart frame supporting said container thereon;

several pairs of wheels provided under said cart frame and rolling on said running rails, each pair of wheels being coupled to each other by a wheel shaft;

a chain and a sprocket engaged with and cooperating with each other for trailing said cart frame on a slope, said chain being provided on said rails, said sprocket being provided on said wheels;

an upper trolley wire provided on one of said support columns such that it directs downward;

a lower trolley wire provided on said lower beam such that it directs upward;

an upper power input unit provided on said cart frame such that it directs upward and meets with said upper trolley wire; and

a lower power input unit provided on a bottom surface of a bottom channel of the cart frame such that it directs downward and meets with said lower trolley wire.

18. The automatic wharfage system according to claim 15 or 17, wherein said power input unit comprises:

a cylinder bracket fixed to a side bottom of the longitudinal beam of said cart frame;

a third hydraulic cylinder having an actuating rod and fixed to said cylinder bracket;

a slide member received in a hollow box and coupled to said actuating rod of the third cylinder, said slide member being biased by a coil spring and vertically sliding in said

hollow box; and

said hollow box having a trolley terminal at its outside.

19. The automatic wharfage system according to claim 1, wherein said longitudinal running rails of the second rotary crane have their hinged connections at positions where said longitudinal running rails cross a pair of gantry crane running rails, said hinged connections being coupled to and driven by actuating rods of a pair of hydraulic cylinders, said actuating rods lifting up said longitudinal running rails of the second rotary crane so as to prevent a possible interference between a lengthwise movement of said second rotary crane along its longitudinal running rails and a transverse movement of said gantry crane along its running rails.

20. The automatic wharfage system according to claim 1, wherein each of said container storage cells includes:

a rectangular frame sloped downward from its input side to its rear side at a gradient of 3/1200;

a plurality of spring-biased rollers provided on said rectangular frame, said rollers being appropriately spaced such that they accommodate all sizes of containers;

a plurality of inside rollers rotatably mounted on inside surfaces of said rectangular frame; and

stoppers provided on opposed rear side ends of said rectangular frame for stopping a longest container.

21. The automatic wharfage system according to any one of claims 10, 12, 13 and 20, wherein each said rectangular sectioned frame, receiving the spring-biased roller therein, includes:

a top opening for receiving said roller therein such that this roller somewhat protrudes out of the top of said frame;

a pair of guide holes formed in opposed side walls of

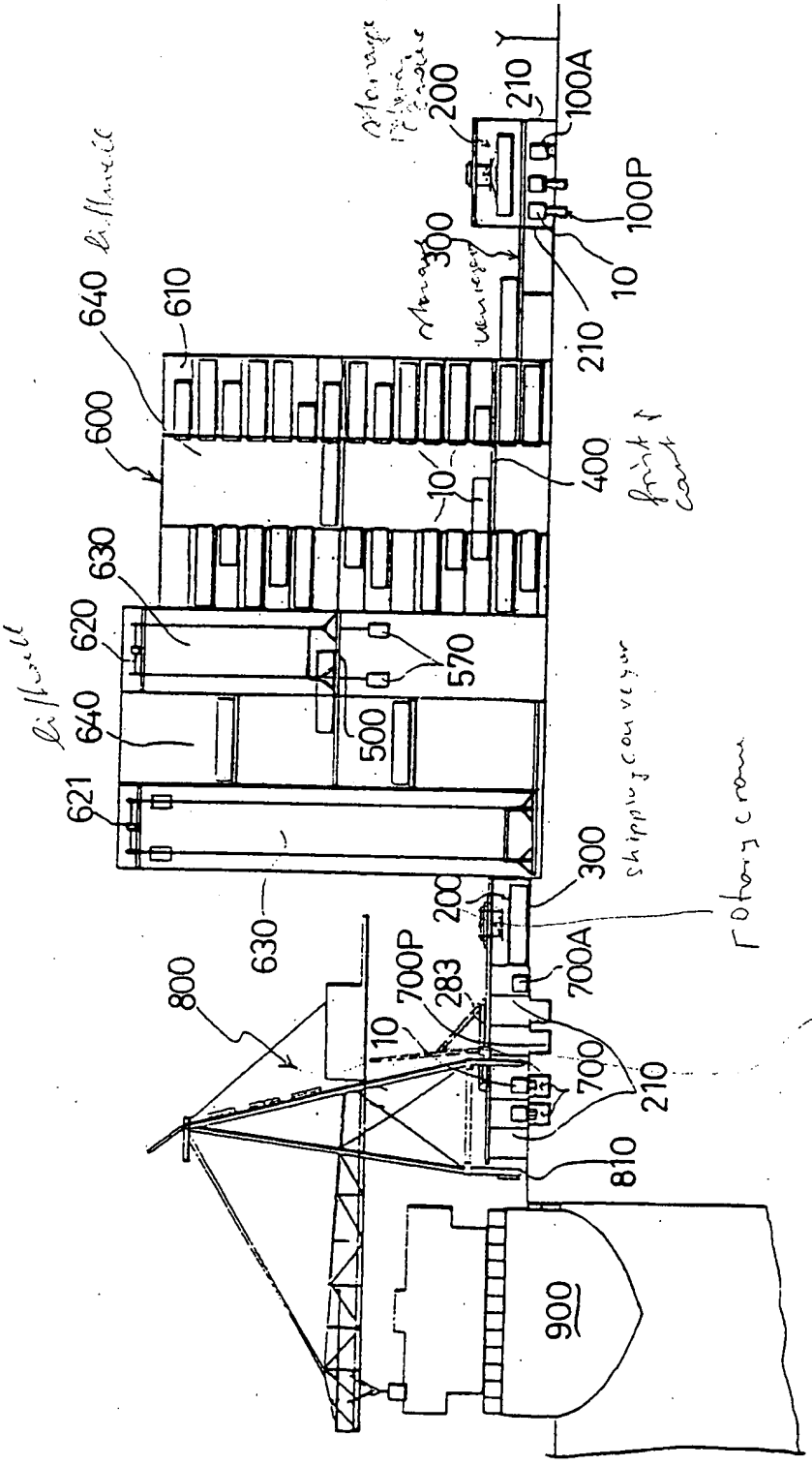
the frame for receiving and supporting opposed ends of a roller shaft of the roller;

a bracket covering both outside bottom and opposed sides of said frame and supporting said opposed ends of said roller shaft; and

a coil spring placed under outside bottom of said bracket for biasing said bracket upward, said spring being received in a spring support frame.

22. The automatic wharfage system according to claim 1, wherein said container is formed with a pair of lengthwise guide grooves at its opposed outside bottom, opposed ends of each said guide groove being widened.

FIG. 1A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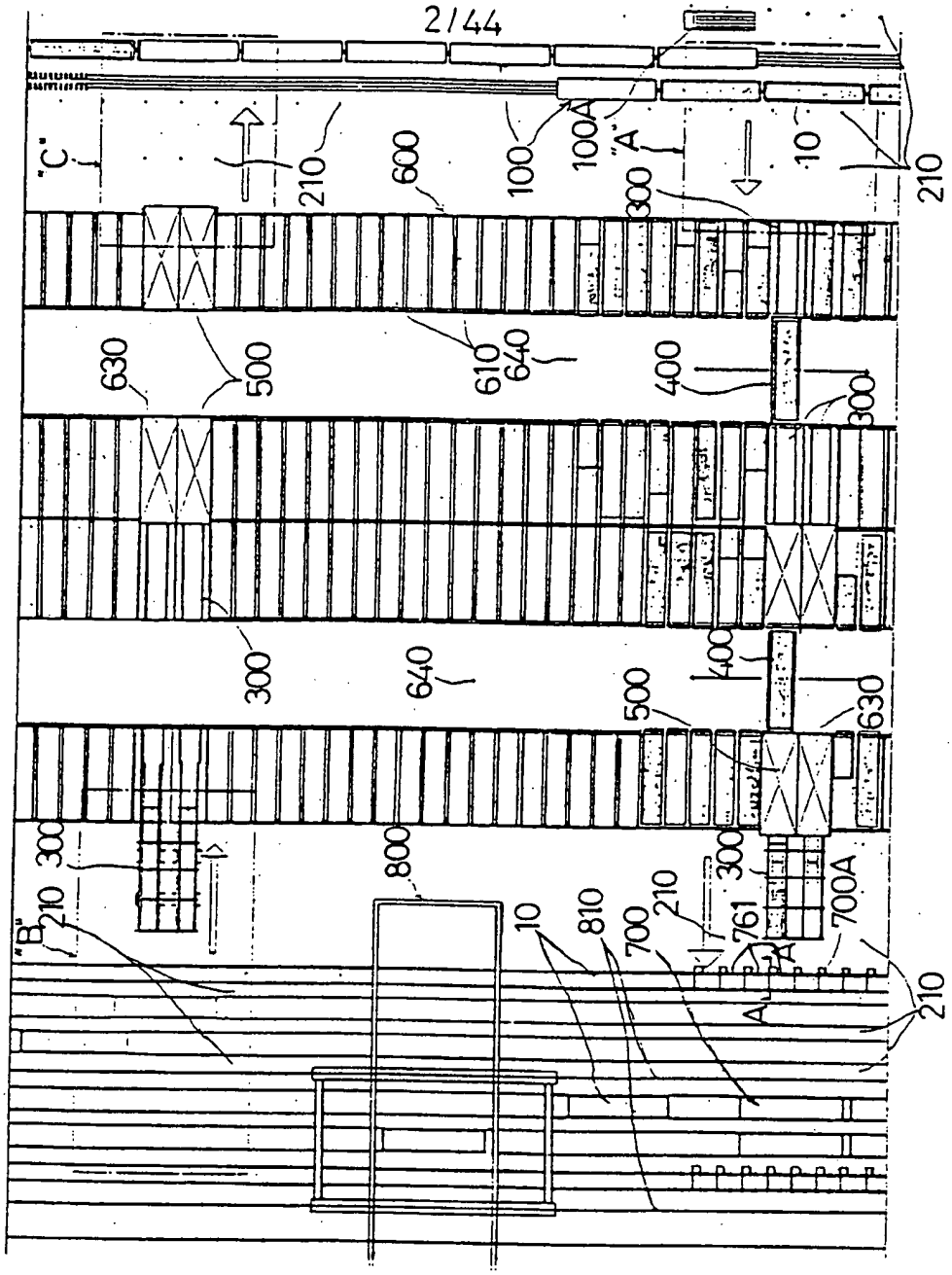
800
810
900


2/44
"C"
"A"
"B"
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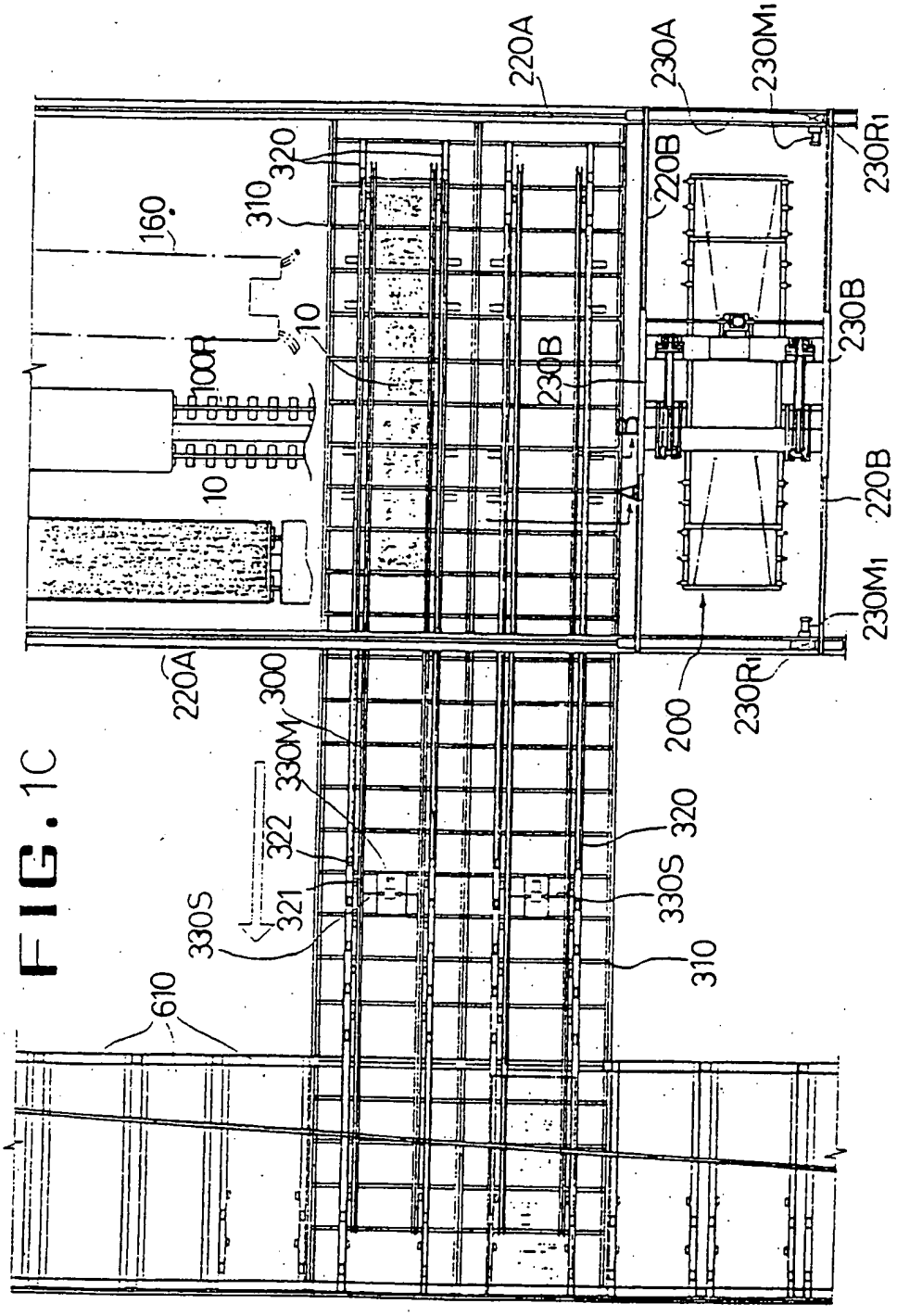
100
100A
300
10
630
500
610
640
400
800
810
700
700A
761

FIG. 1B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230A
230M1
230R1
220B
230B
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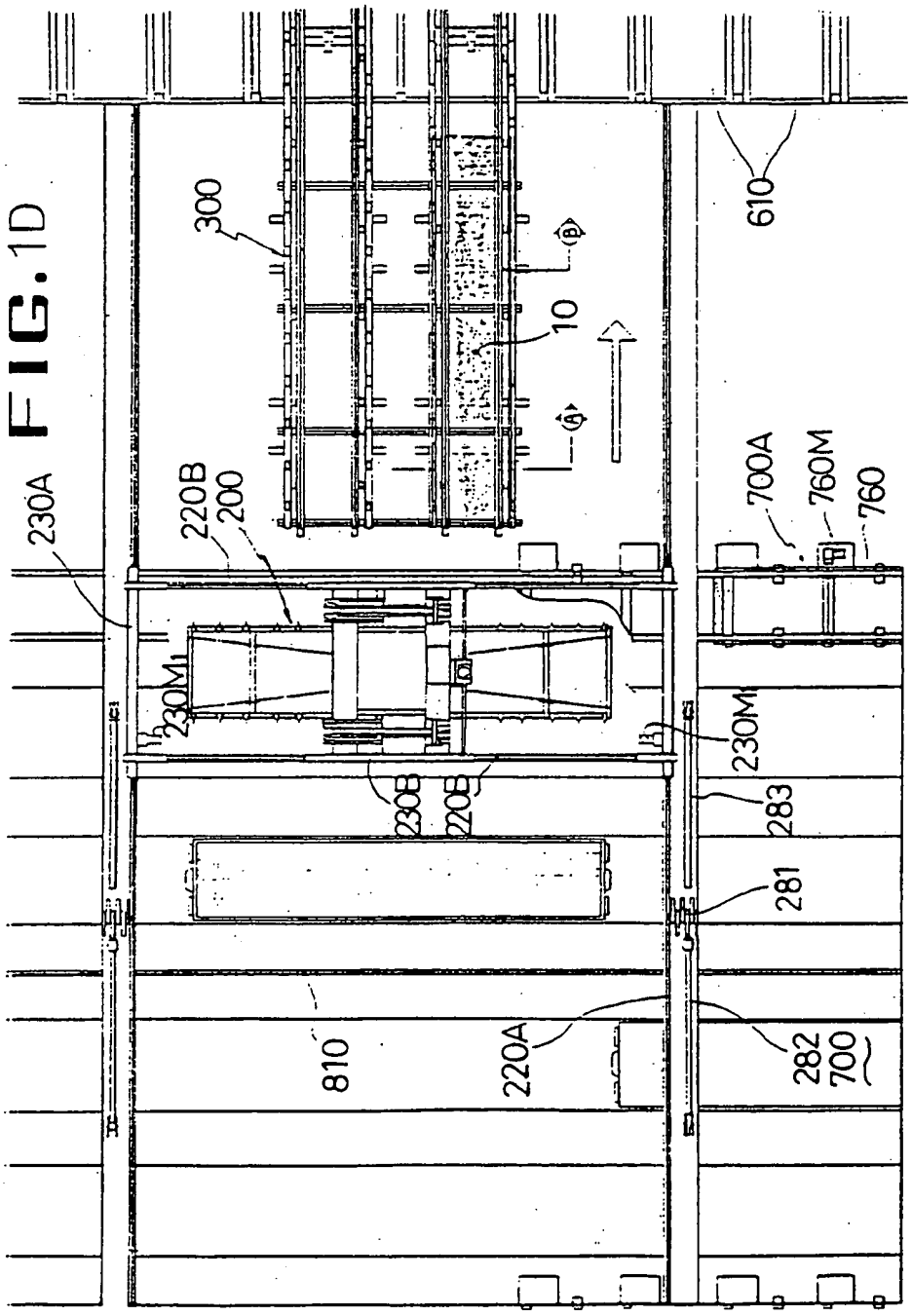
310
320
10
100R
200
300
330M
322
321
330S
610

FIG. 1C

FIG.1D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B
A
230A
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220B
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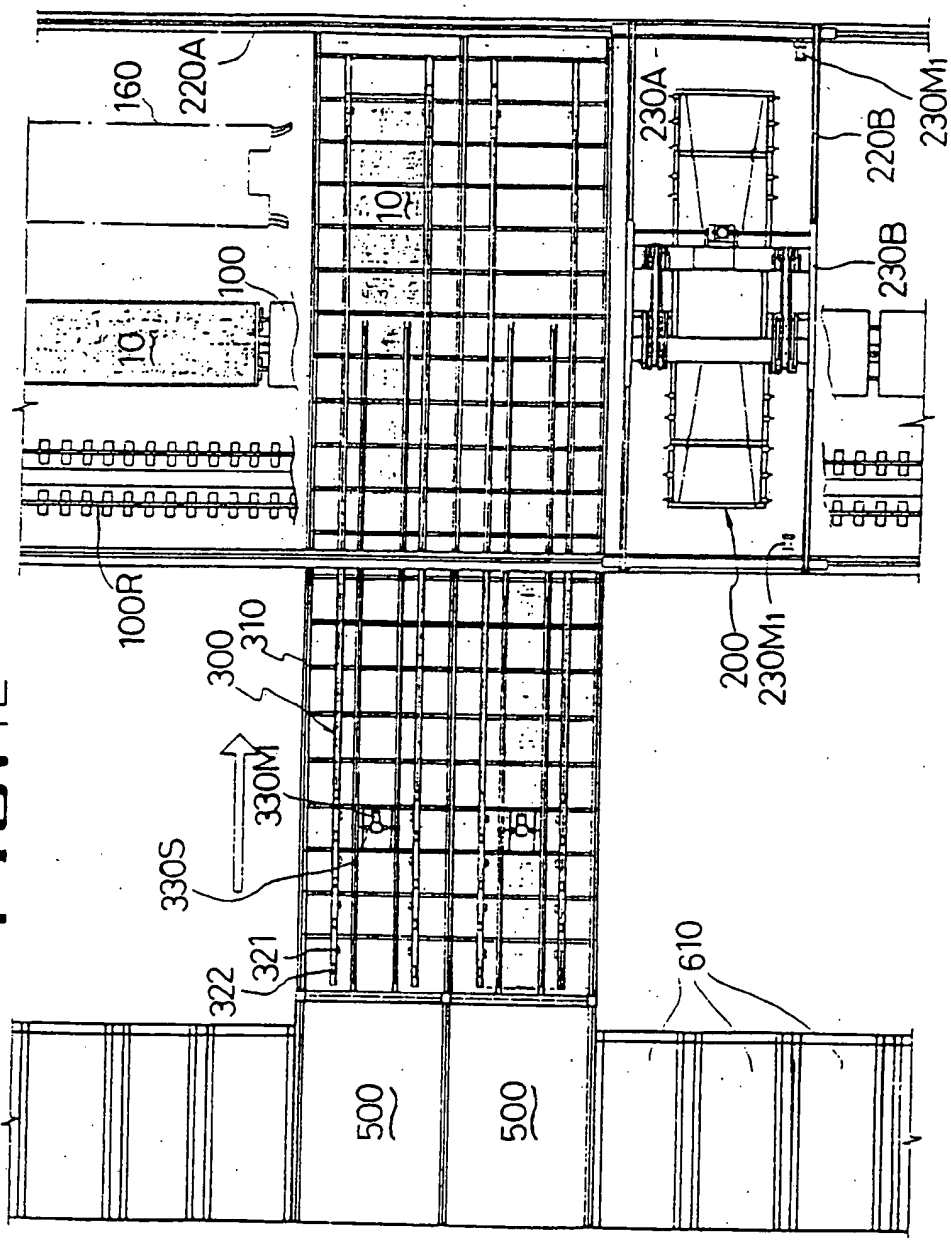
810
220A
282
700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220A
10
100
10
100R
300
310
330M
330S
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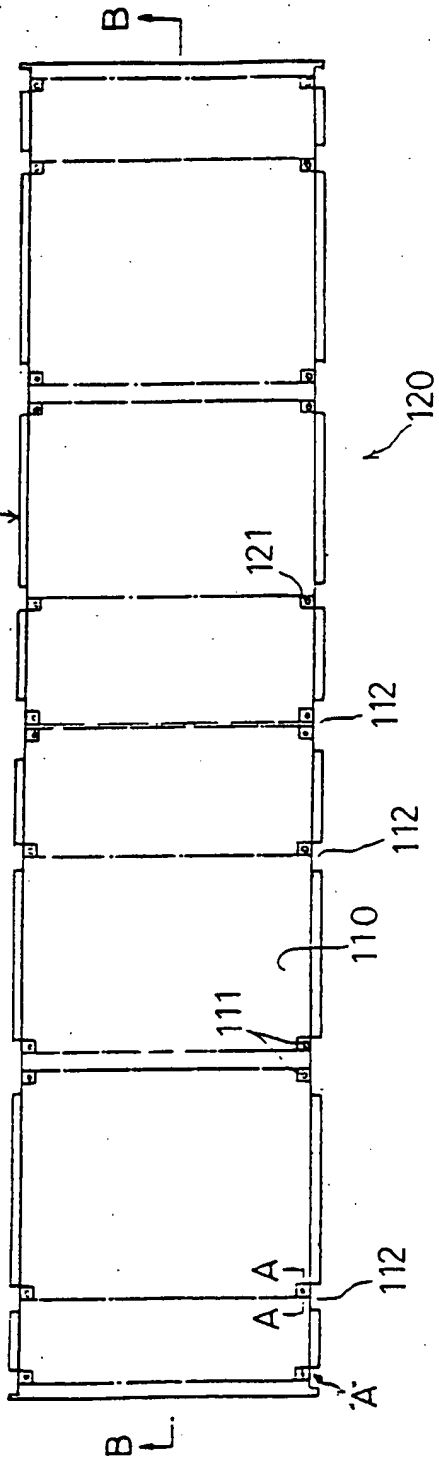
500
610
200
230M1
230A
230M1
220B
230B

FIG. 1E

FIG.2A


B
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121
112
112
110
111
112
A
A
A'
B

FIG.2B

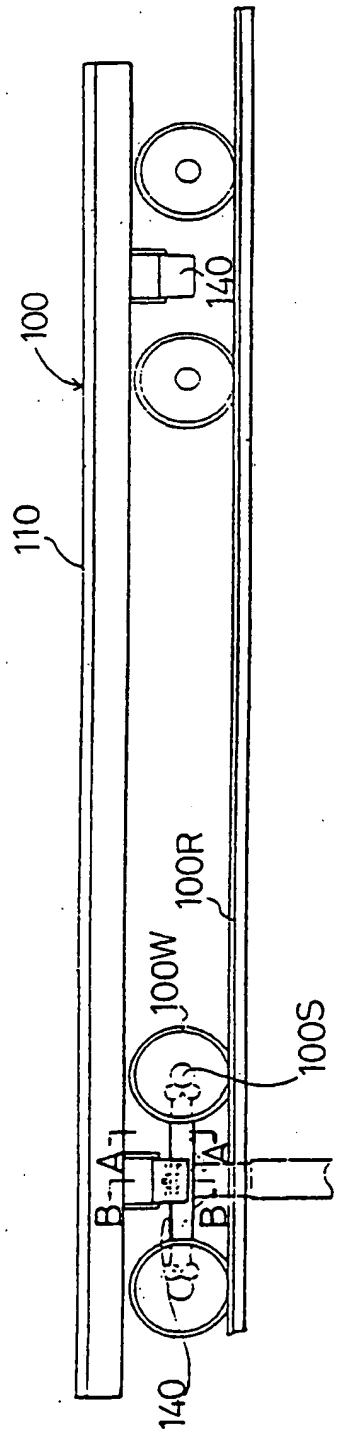
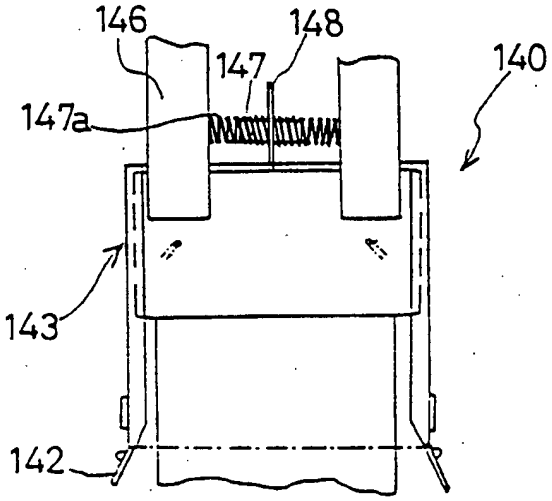

100
140
110
100R
100W
100S
B
A
A
B
140

FIG. 2C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147a
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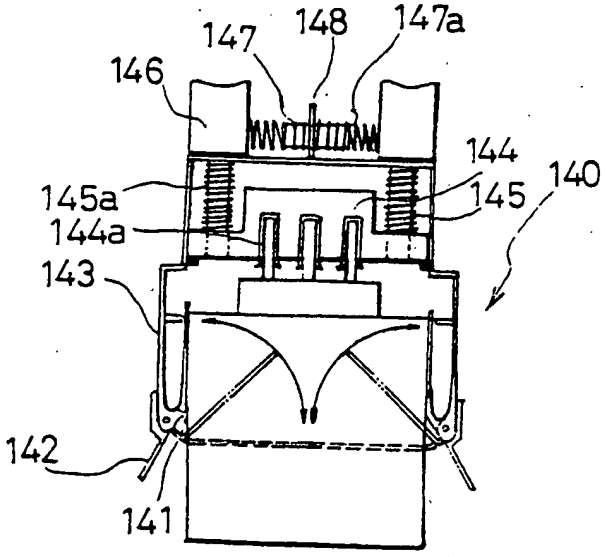
142

FIG. 2D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140
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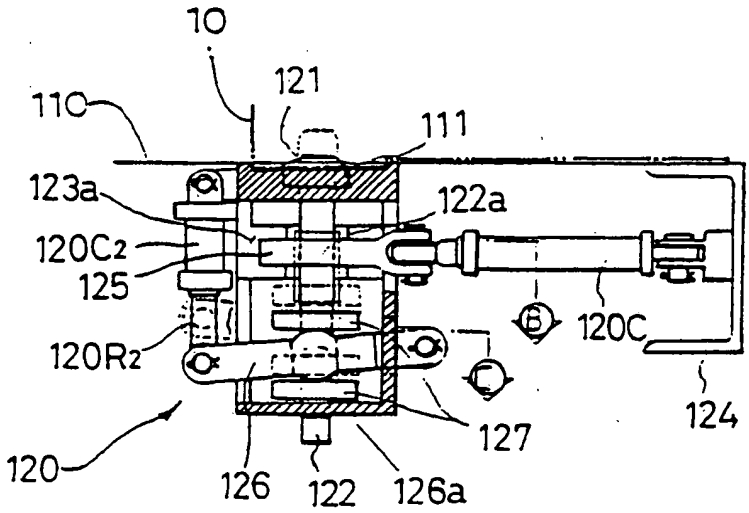
142
141

FIG. 2E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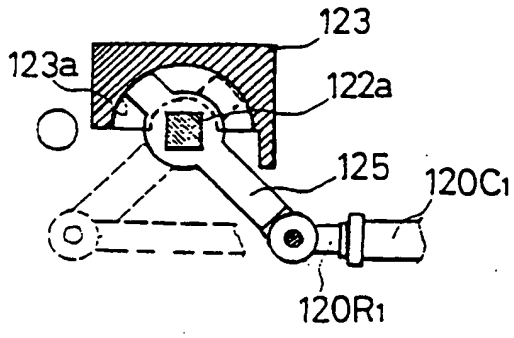
121
110
111
123a
122a
120C2
125
120C
120R2
124
127
120
126
122
126a

FIG. 2F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123a
122a
125
120C1
120R1

FIG. 2G

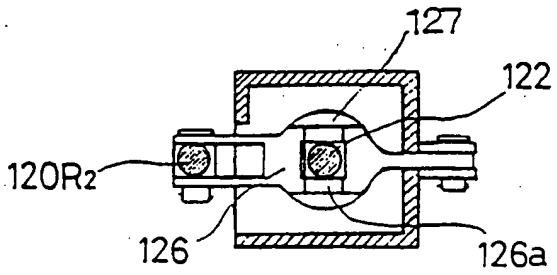


FIG. 2H

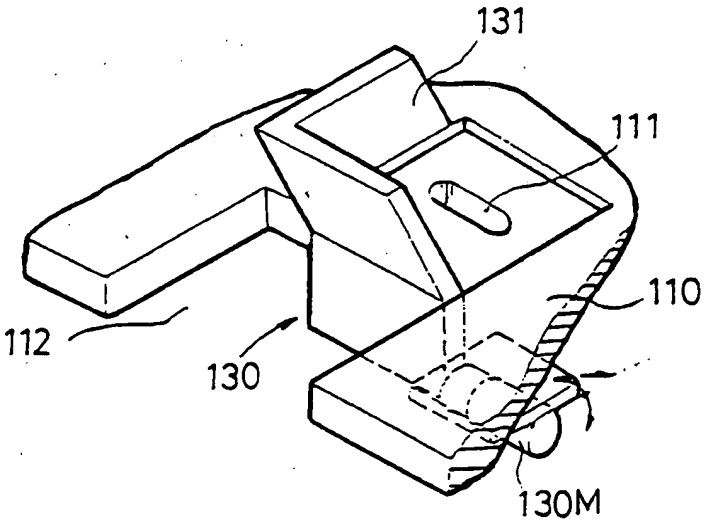
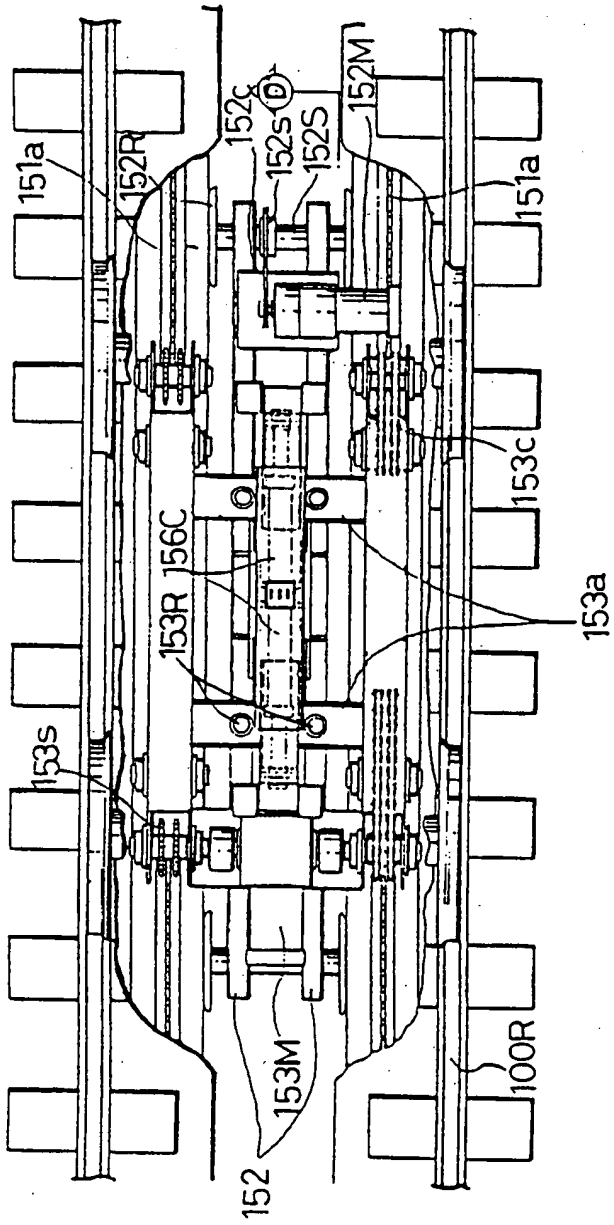


FIG.21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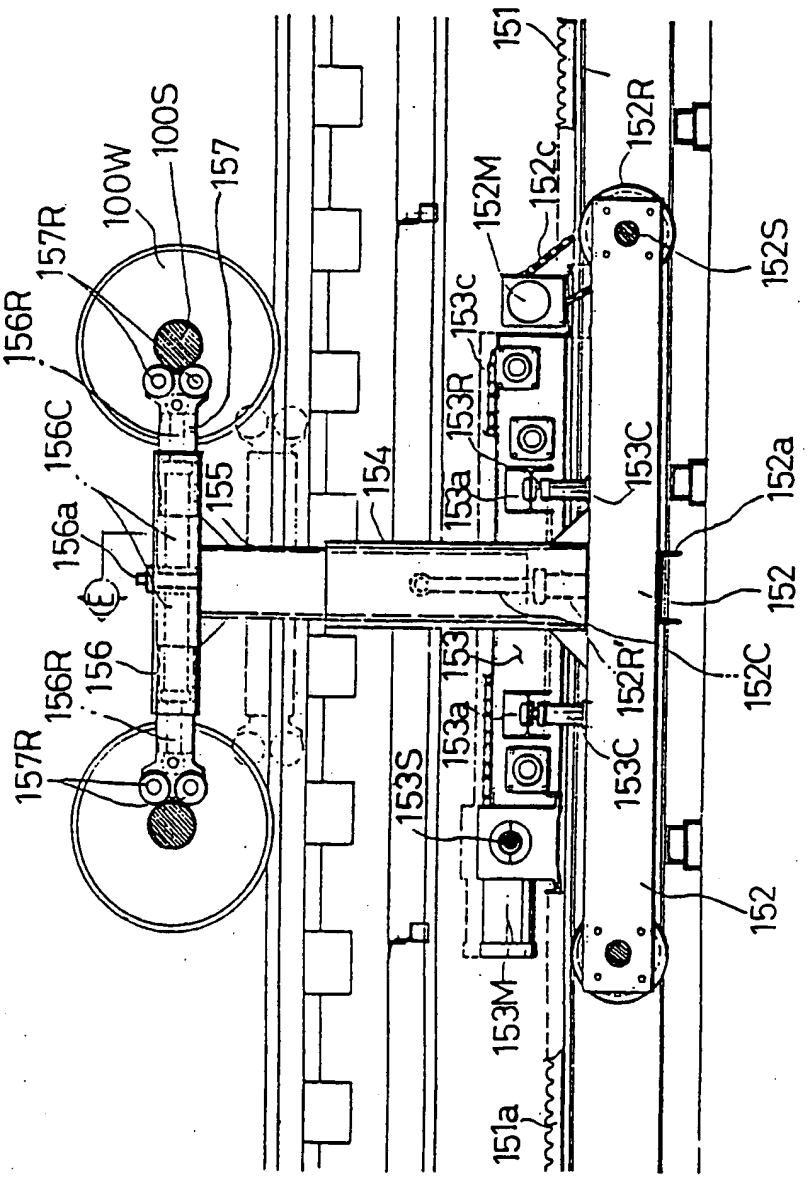
152R
152c
152s
152S
152M
151a
153c
156C
153R
153a
153s
153M
100R
152

FIG. 2J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152c
153c
153R
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152
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152R
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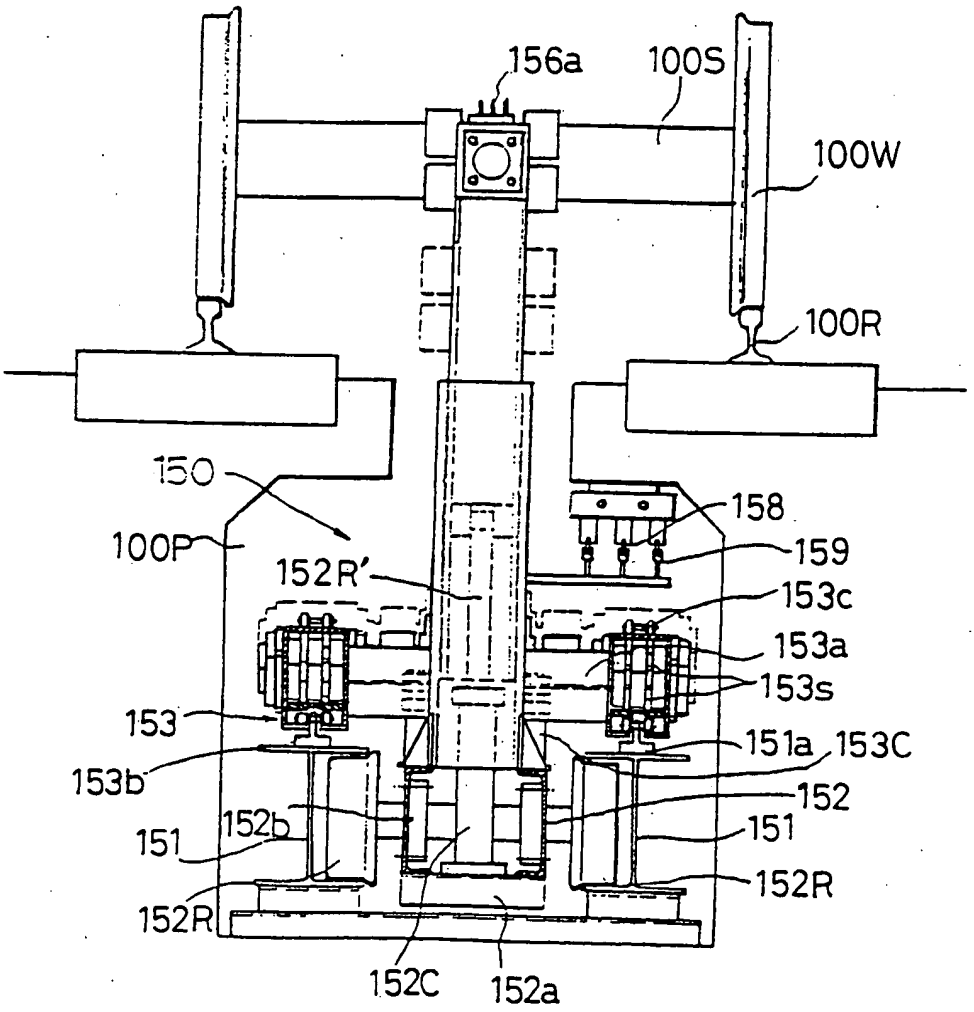
151a
154
155
156
156R
156C
156a
157
157R
100W
100S

FIG. 2K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100R
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100P
152R'
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153c
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153s
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153b
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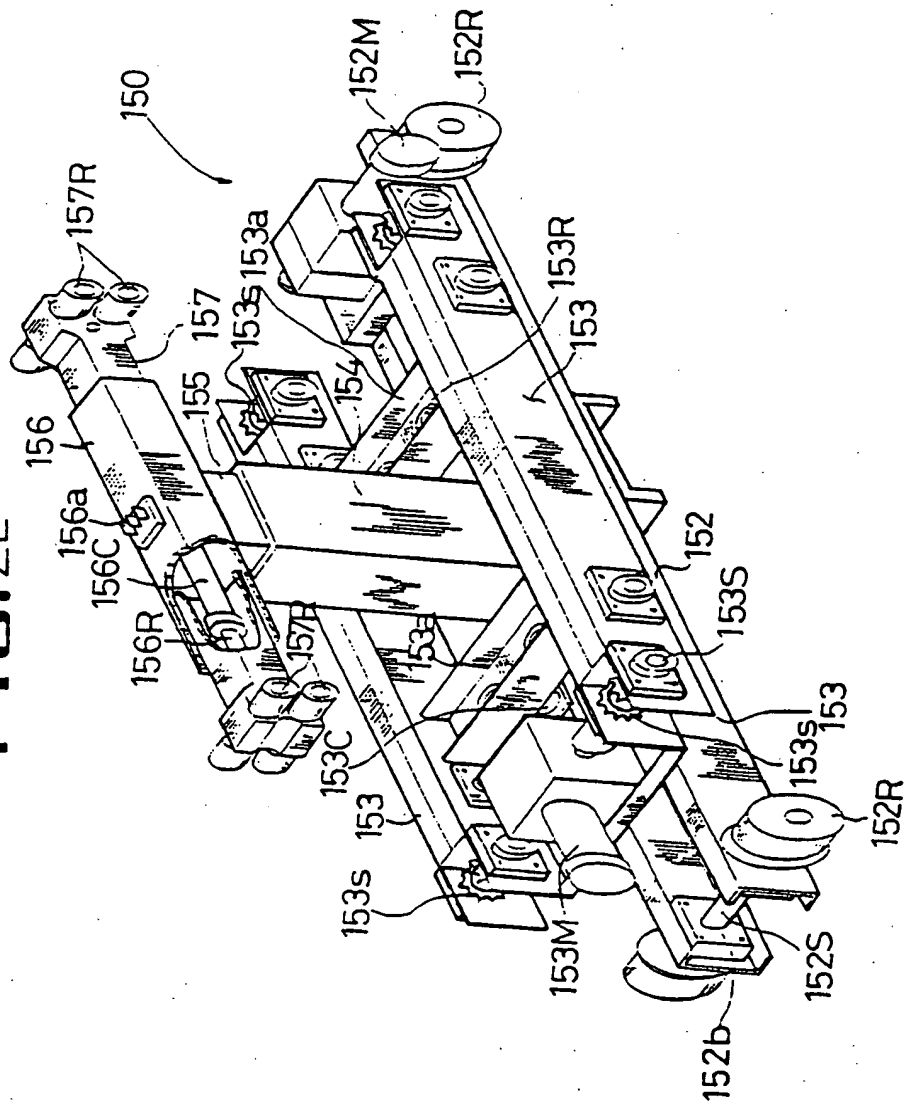
152
151
152b
151
152R
152R
152C
152a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153R
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153s
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156a
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156R
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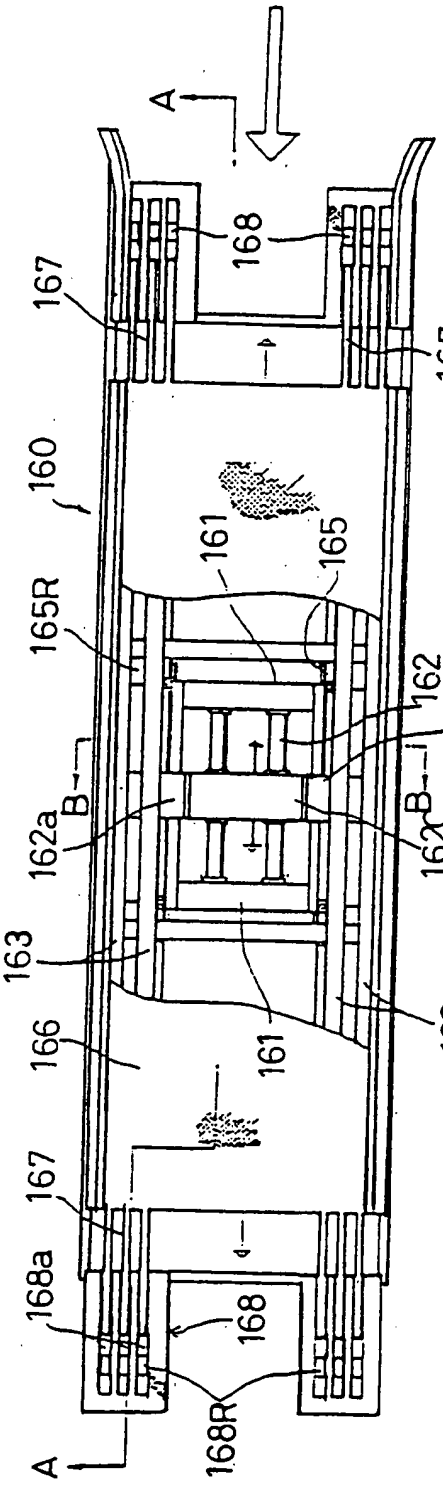
153
153s
153M
152R
152S
152b

FIG. 2L


A
168
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161
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165R
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B
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162C
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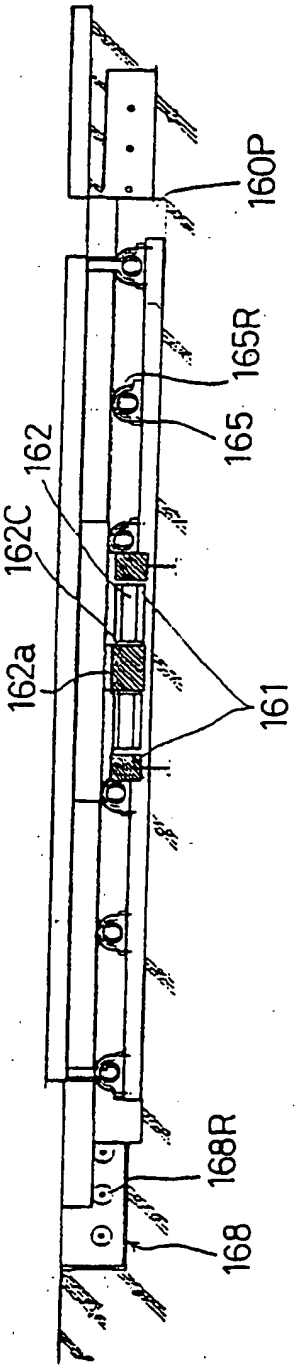
161
163
167
168a
168
168R
A

FIG.3A


160P
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168

FIG.3B

FIG.3C

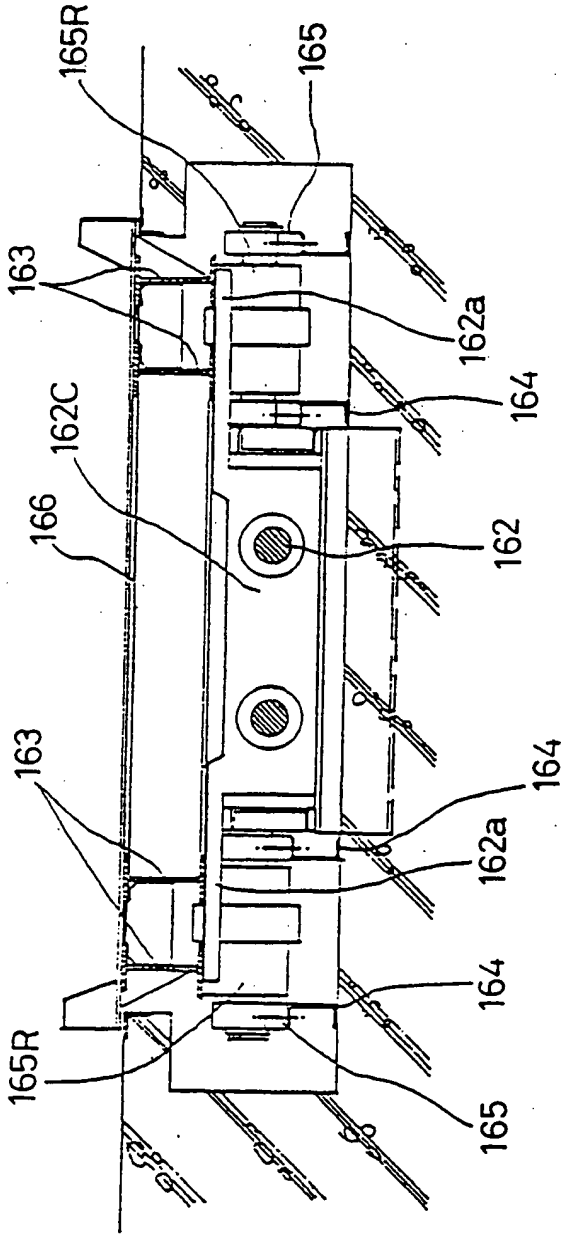


FIG. 4A

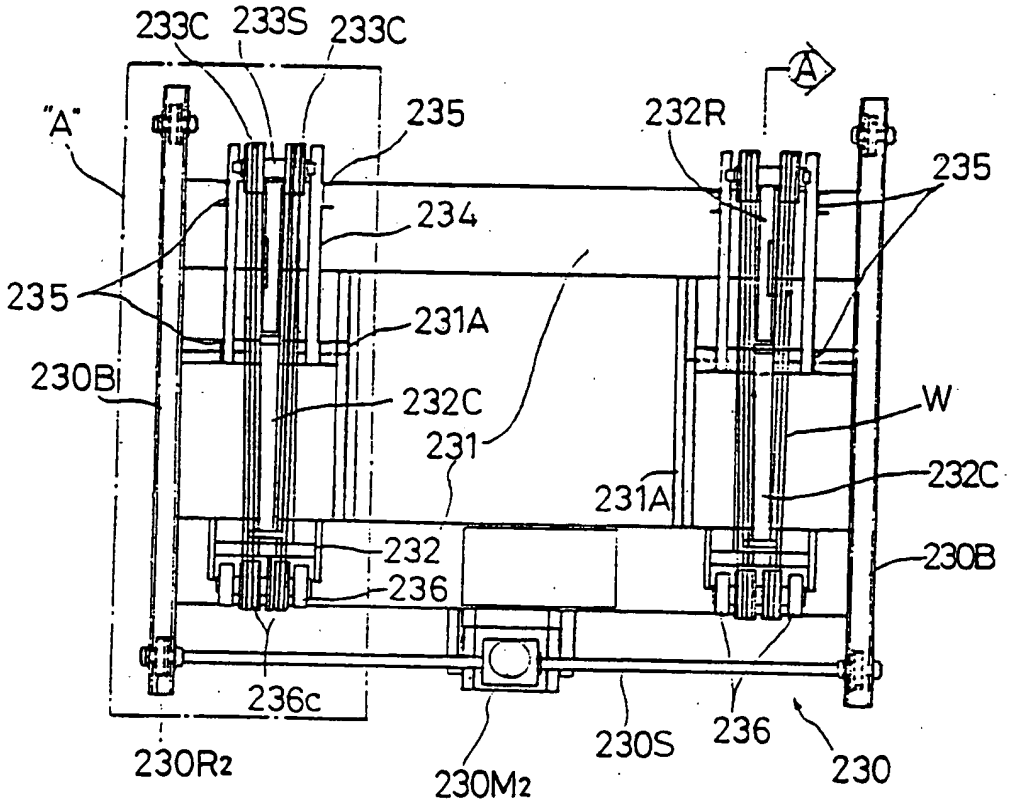

233C
233S
233C
"A"
235
232R
A
235
234
235
231A
230B
232C
231
W
231A
232C
232
230B
236
236c
230R2
230M2
230S
236
230

FIG. 4B

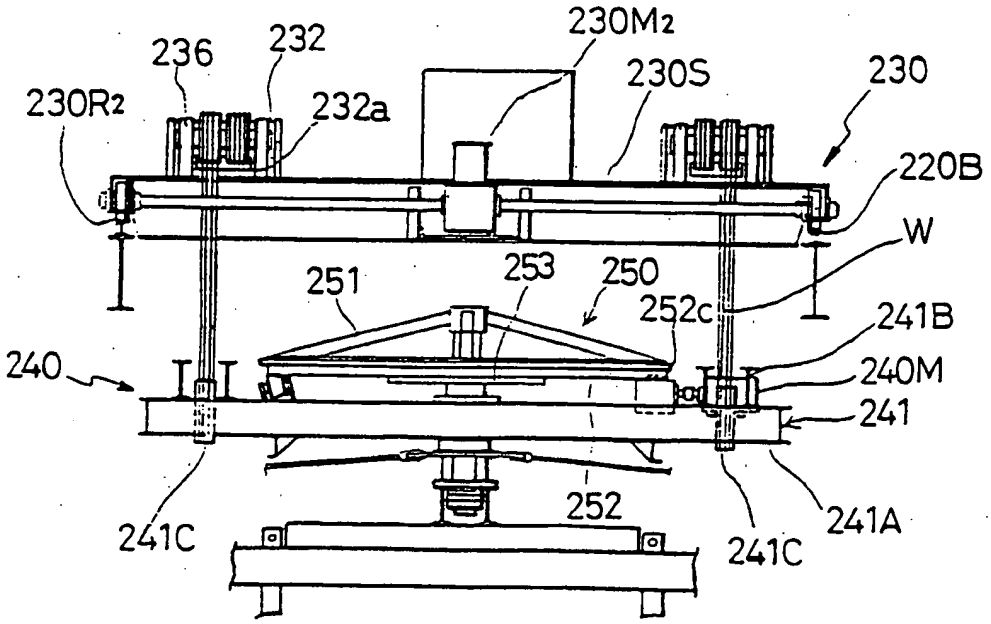

230M2
236
232
230S
230
230R2
232a
220B
W
251
253
250
252c
241B
240
240M
241
252
241C
241C
241A

FIG. 4C

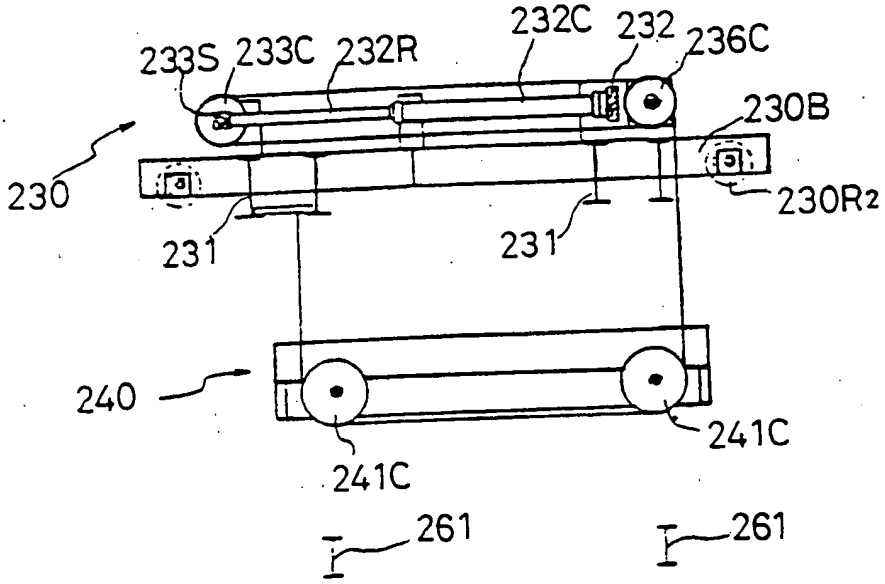
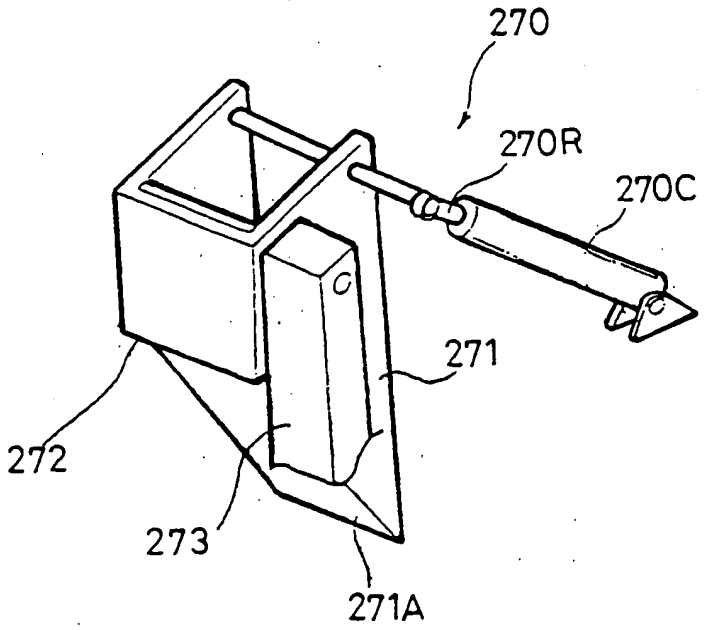

232C
232
236C
233S
233C
232R
230B
230
230R2
231
231
240
241C
241C
261
261

FIG. 4H


270
270R
270C
271
272
273
271A

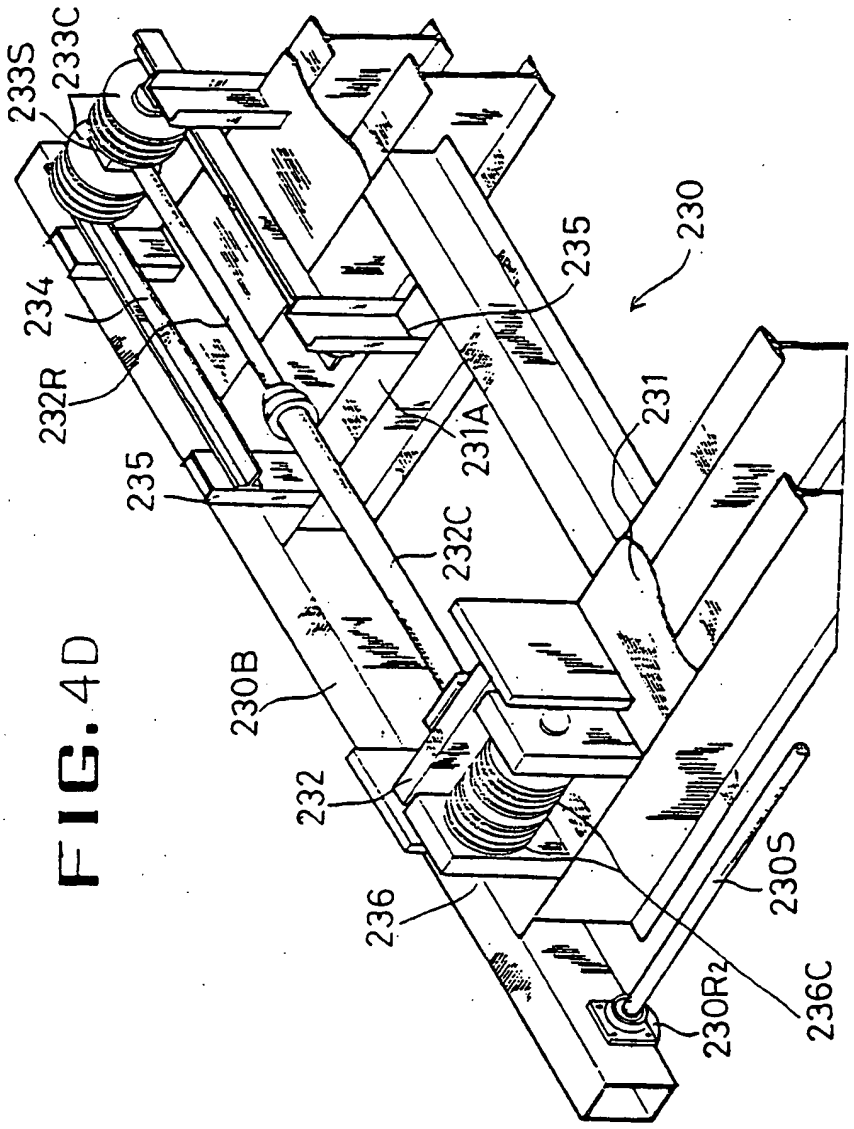

233S
233C
234
232R
235
230
235
231
231A
232C
230B
232
236
230S
230R2
236C

FIG. 4D

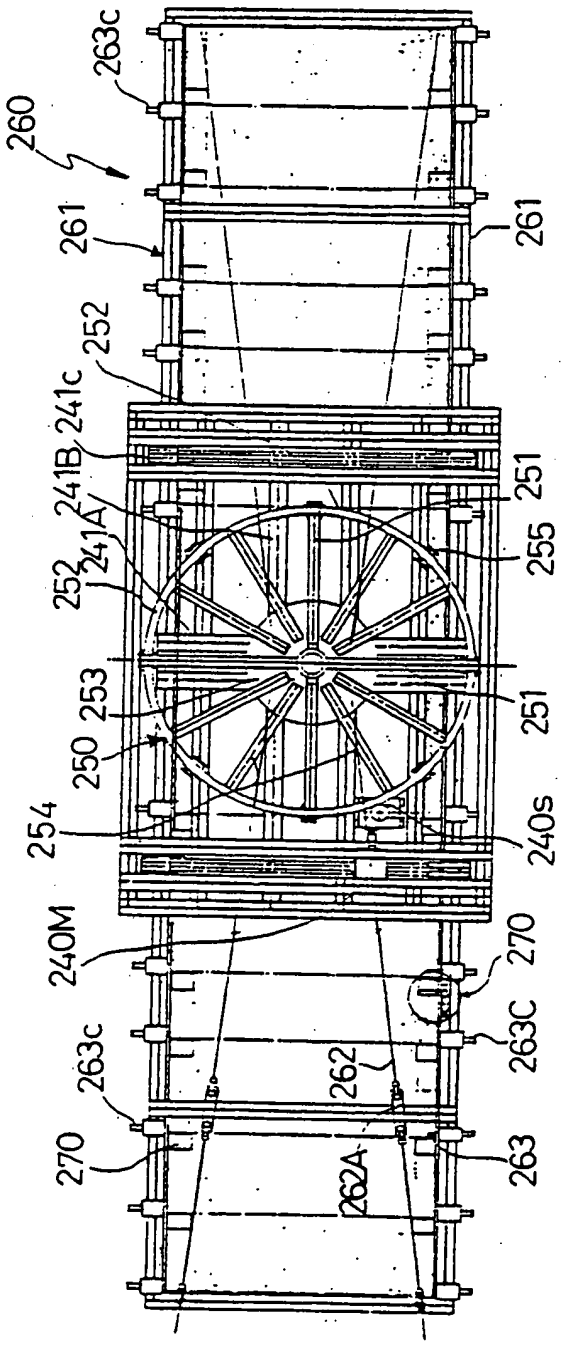

263c
260
261
261
252
241c
241B
241A
252
251
255
253
251
250
254
240s
240M
270
263C
263c
262
270
263
262A

FIG. 4E

FIG. 4F

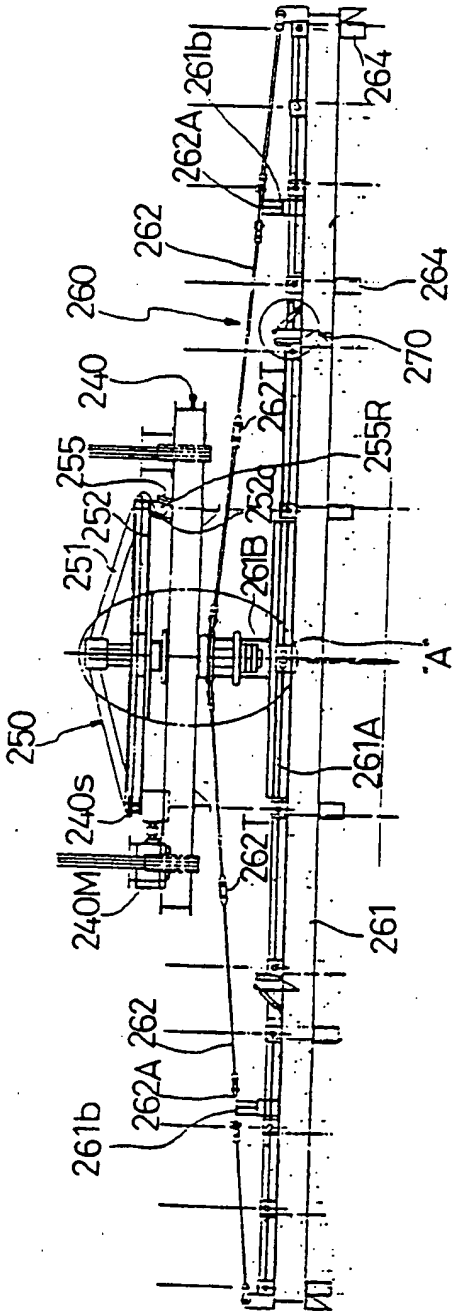
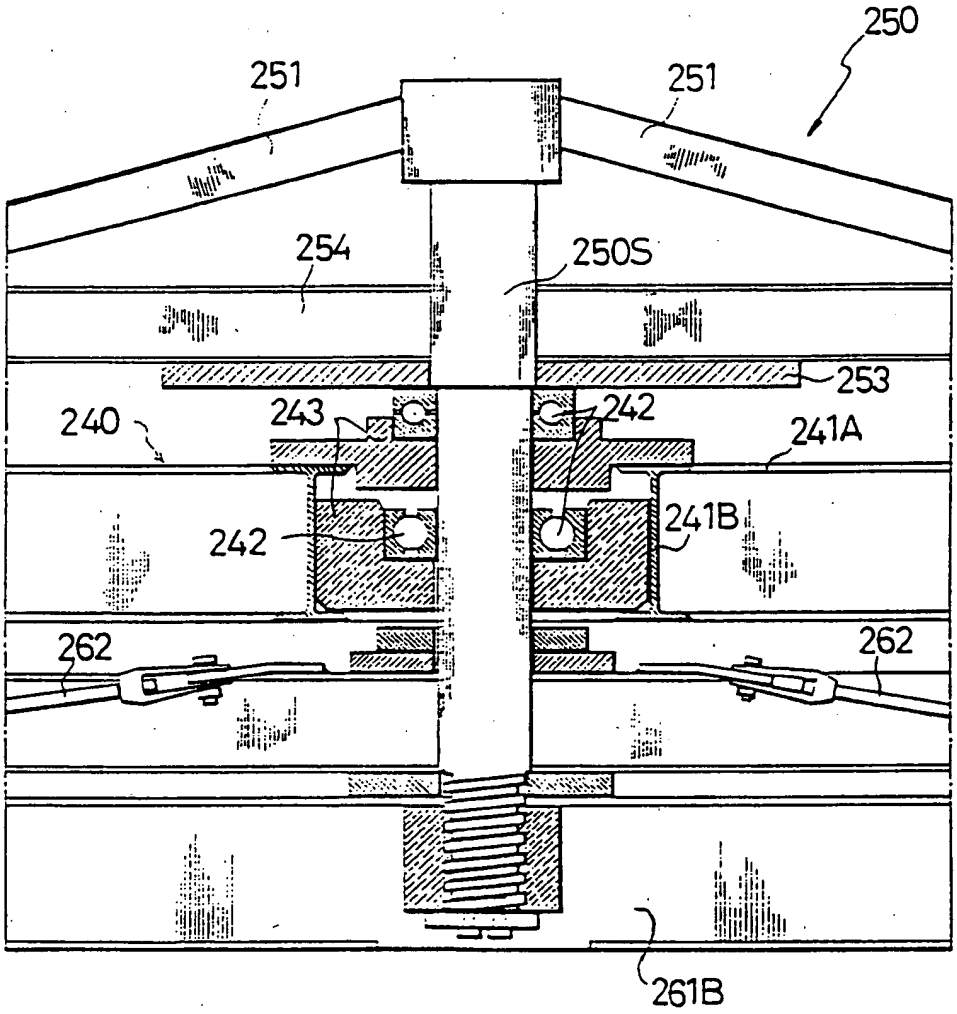

261b
262A
262
260
240
255
252
251
250
240s
240M
262
262A
261b
264
264
270
262T
255R
252a
261B
A
261A
262T
261

FIG. 4G



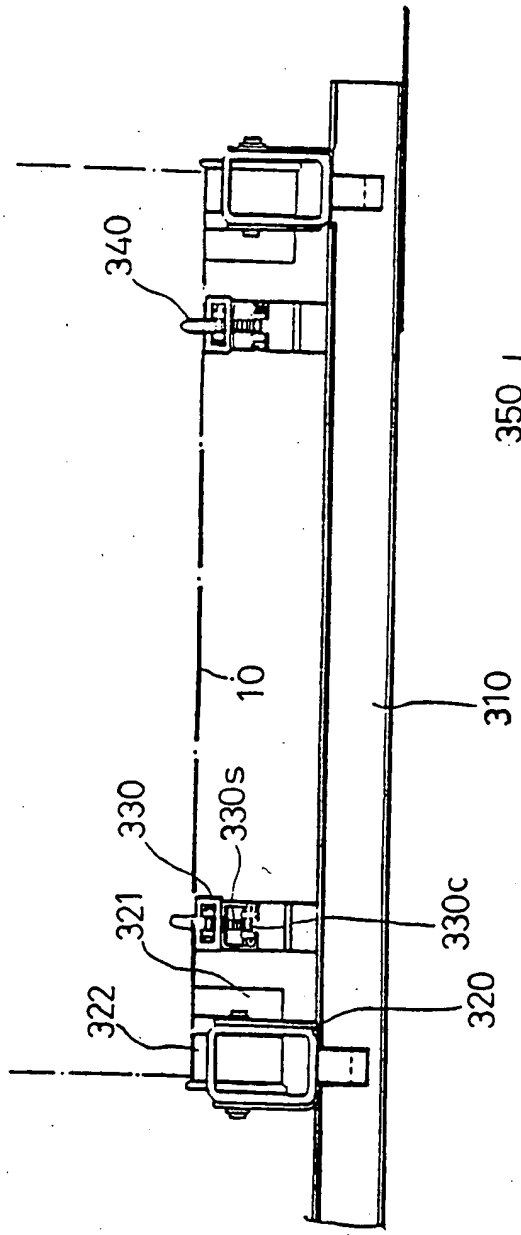


FIG.5A

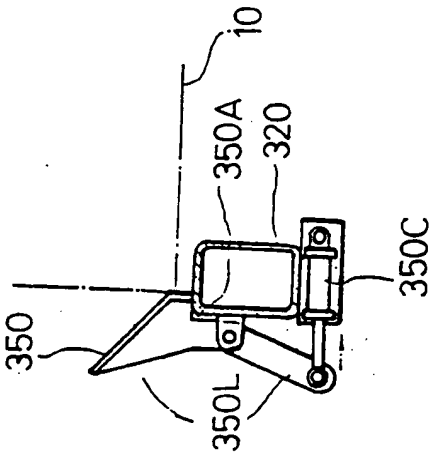


FIG.5B

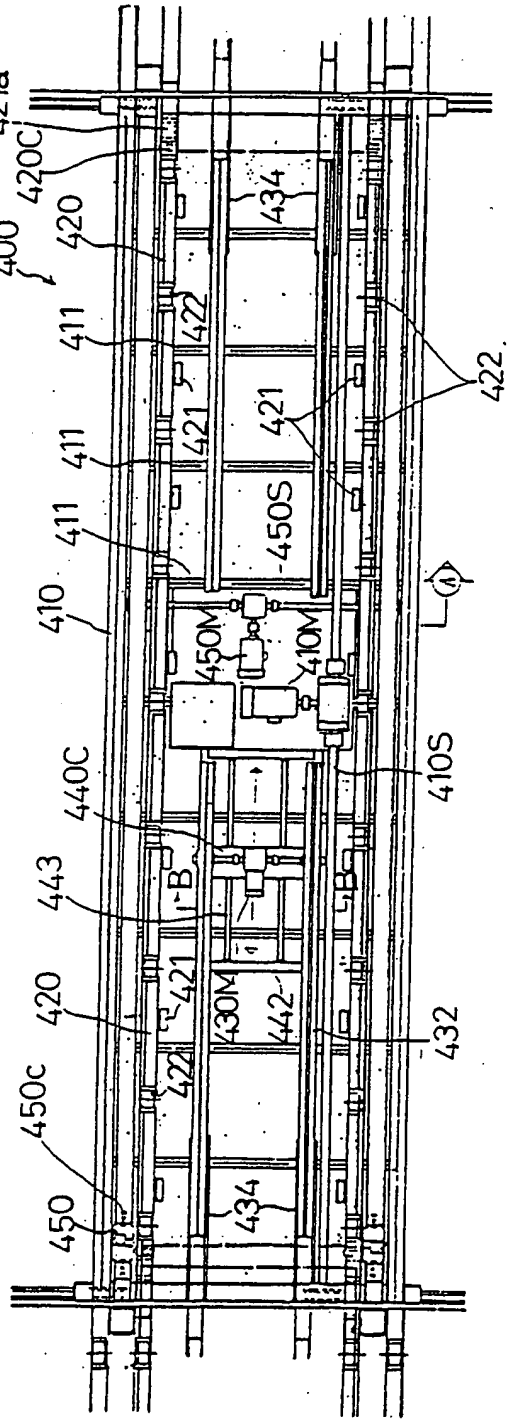

421a
420C
400
420
411
422
421
411
411
410
450S
450M
410M
440C
443
B
B
420
421
430M
442
432
422
450c
450
434
434
422

FIG. 6A

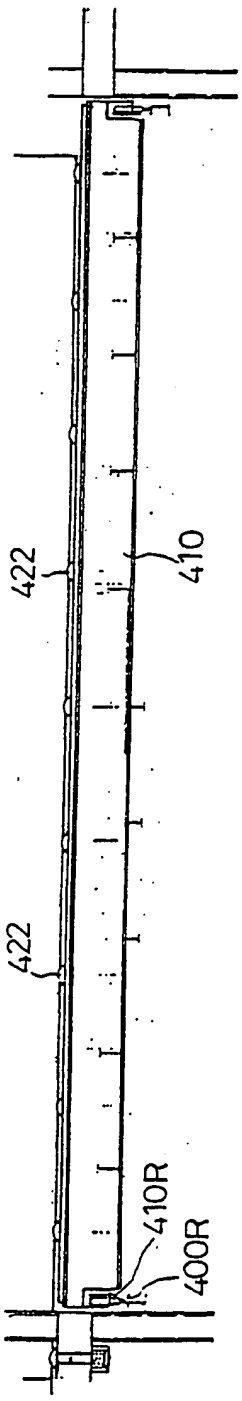

422
410
422
410R
400R

FIG. 6B

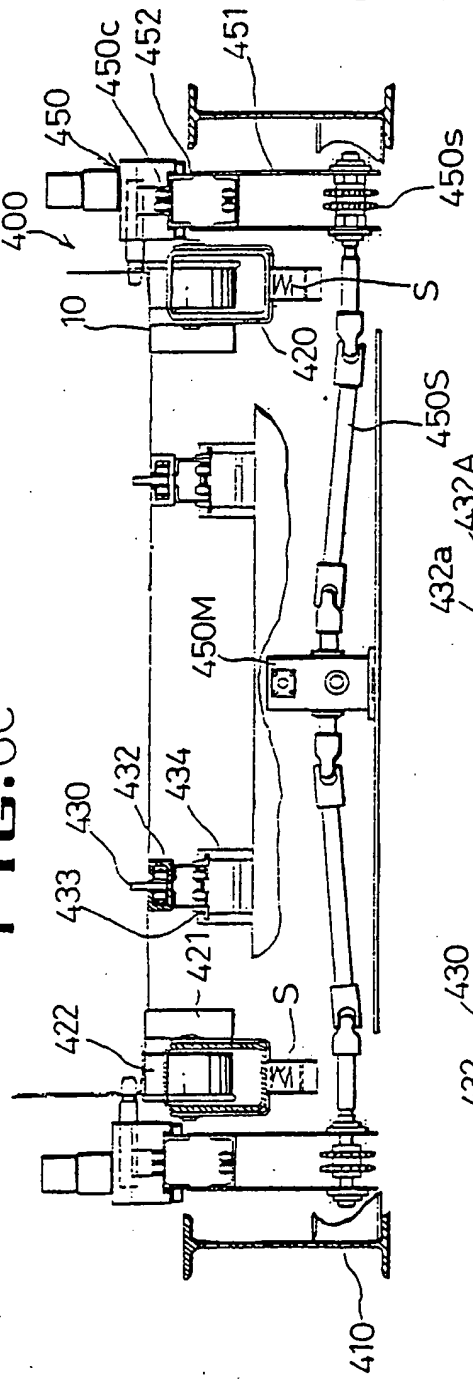

400
450
450c
452
451
450s
10
S
420
450S
450M
432
434
430
433
421
422
410

FIG. 6C

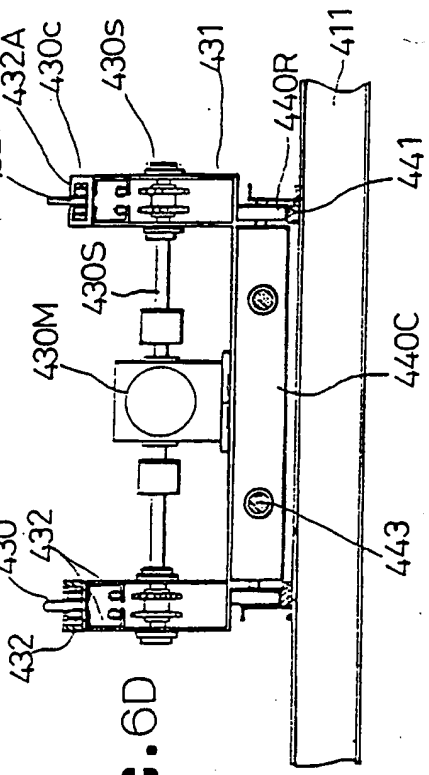

432A
430c
430s
431
411
440R
432a
441
430S
430M
440C
443
430
432

FIG. 6D

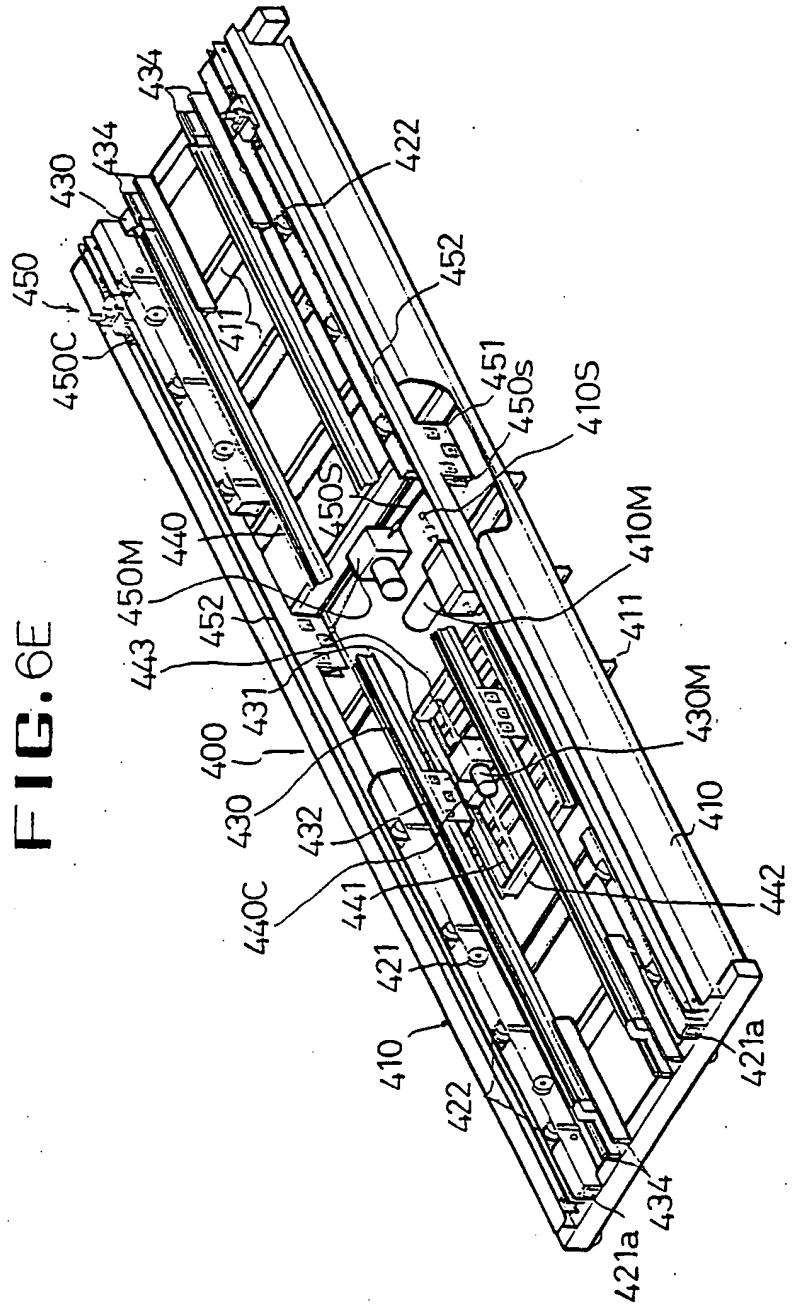

434
434
430
450
450C
411
422
452
451
450s
410S
450S
440
450M
452
443
431
400
430
432
440C
441
421
410
422
421a
434
421a
442
410
430M
410M
411

FIG. 6E

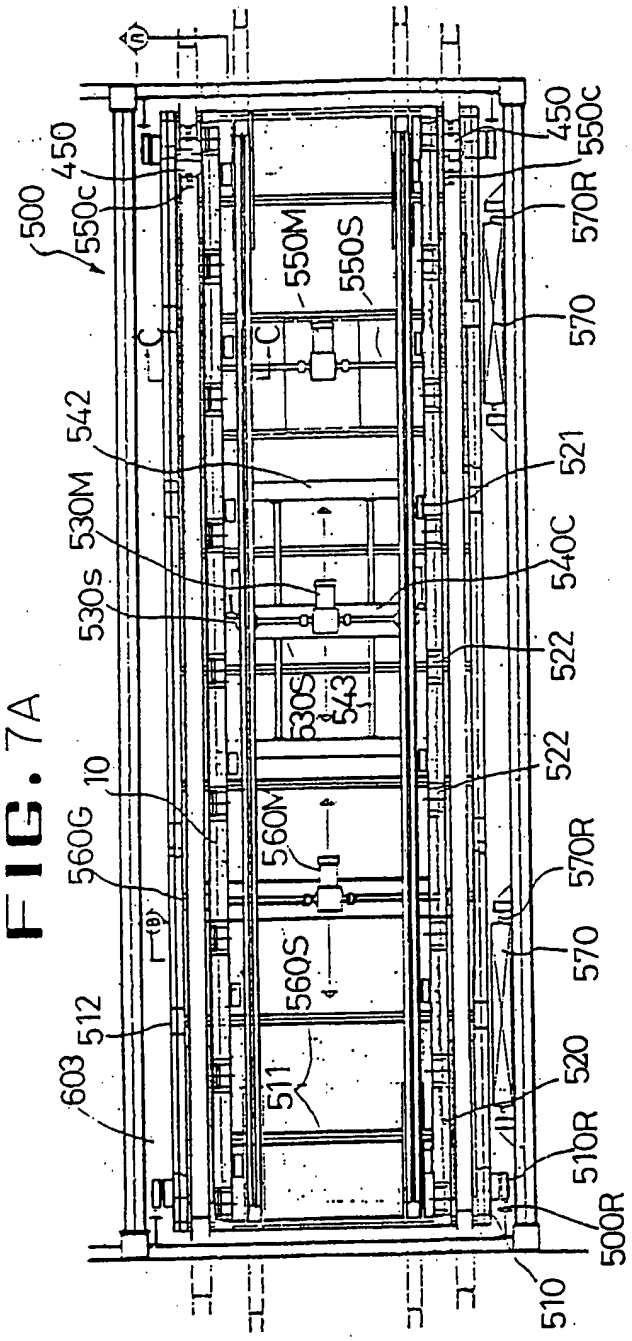

500
450
550c
550M
550S
570
570R
450
550c
542
530M
530s
521
540C
522
530S
543
522
560G
10
560M
570R
570
560S
512
603
511
520
510R
500R
510

FIG. 7A

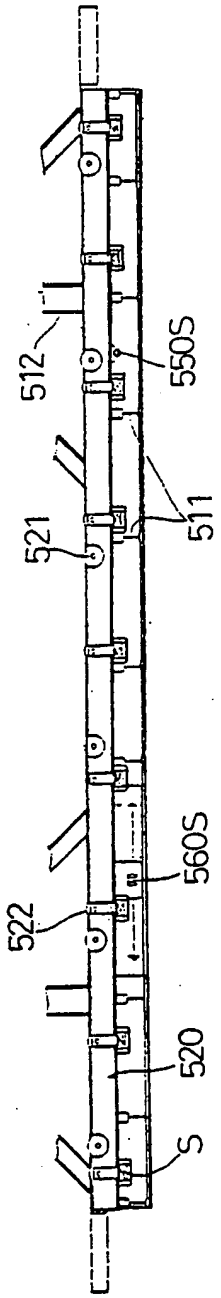

512
550S
521
511
522
560S
520
S

FIG. 7B

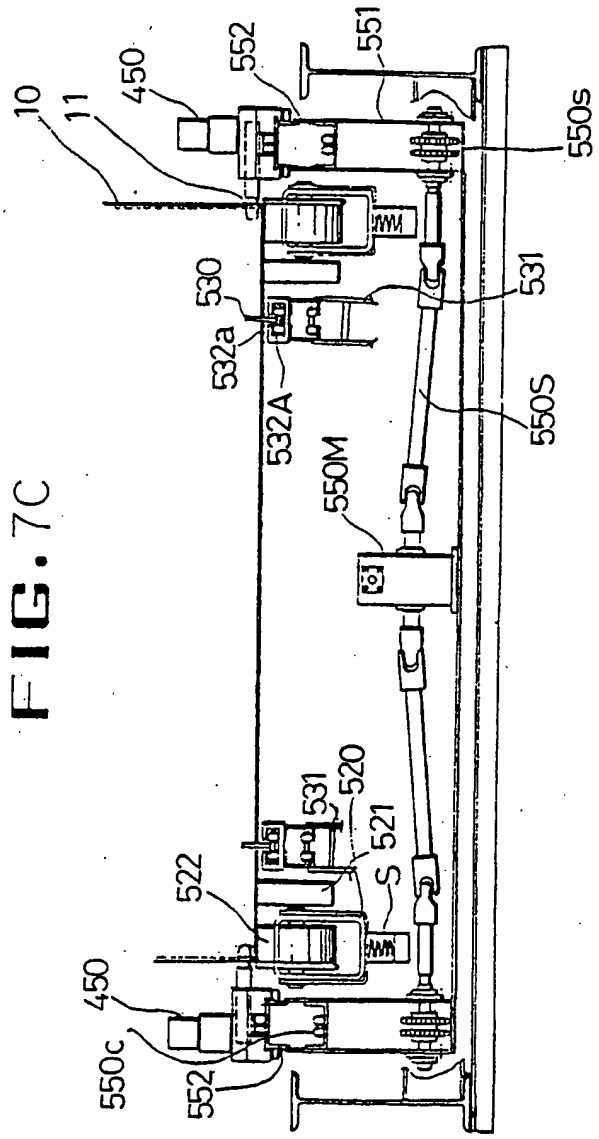

10
11
450
552
551
550s
530
531
532a
532A
550S
550M
520
521
S
522
450
550c
552

FIG. 7C

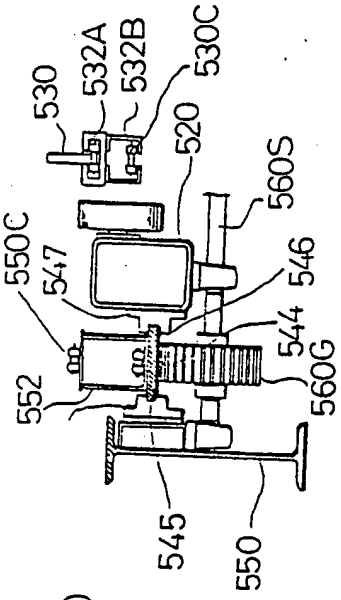

530
532A
532B
530C
520
560S
550C
547
546
544
560G
552
545
550

FIG. 7D

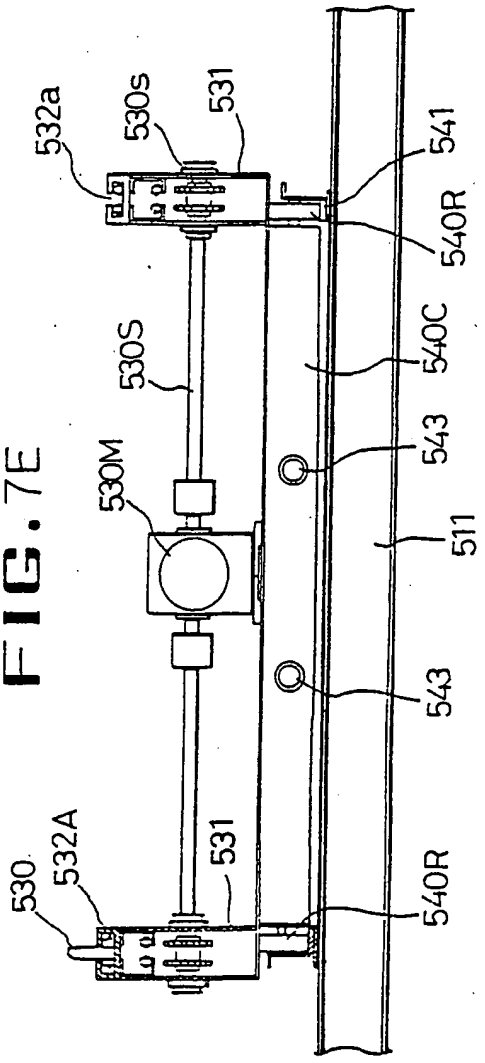

532a
530s
531
541
540R
530S
540C
543
530M
511
543
530
532A
531
540R

FIG. 7E

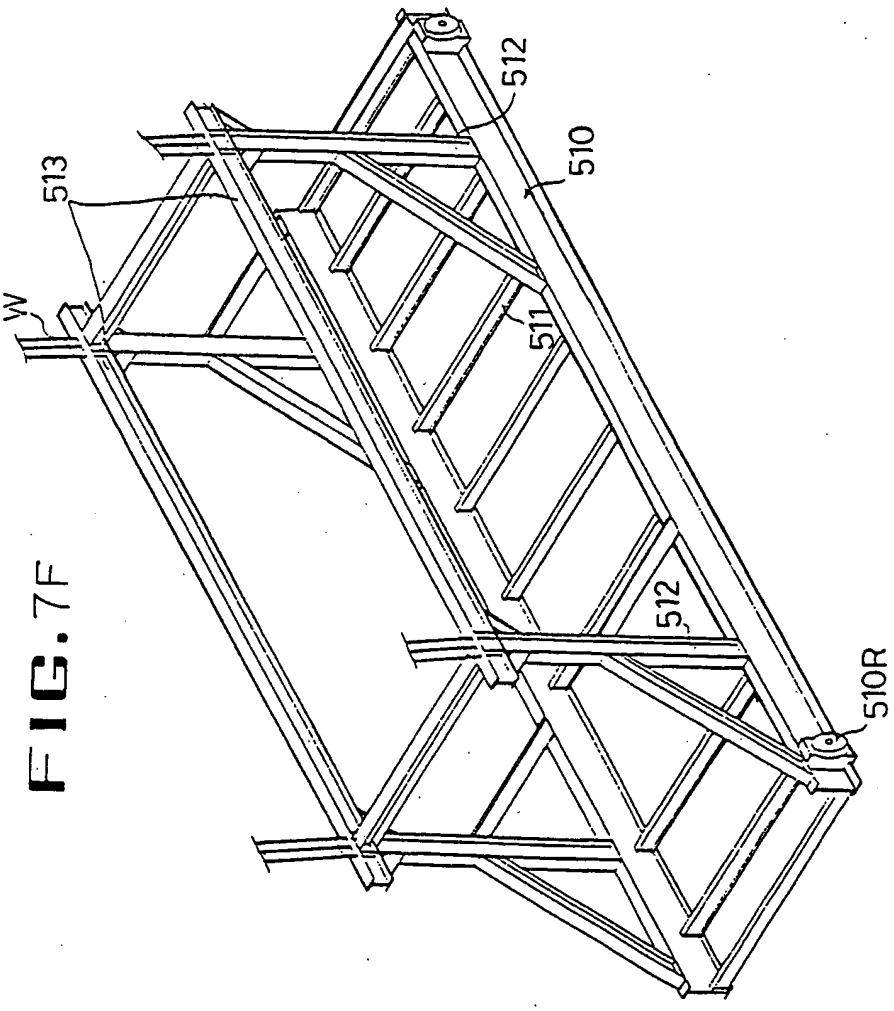


FIG. 7F

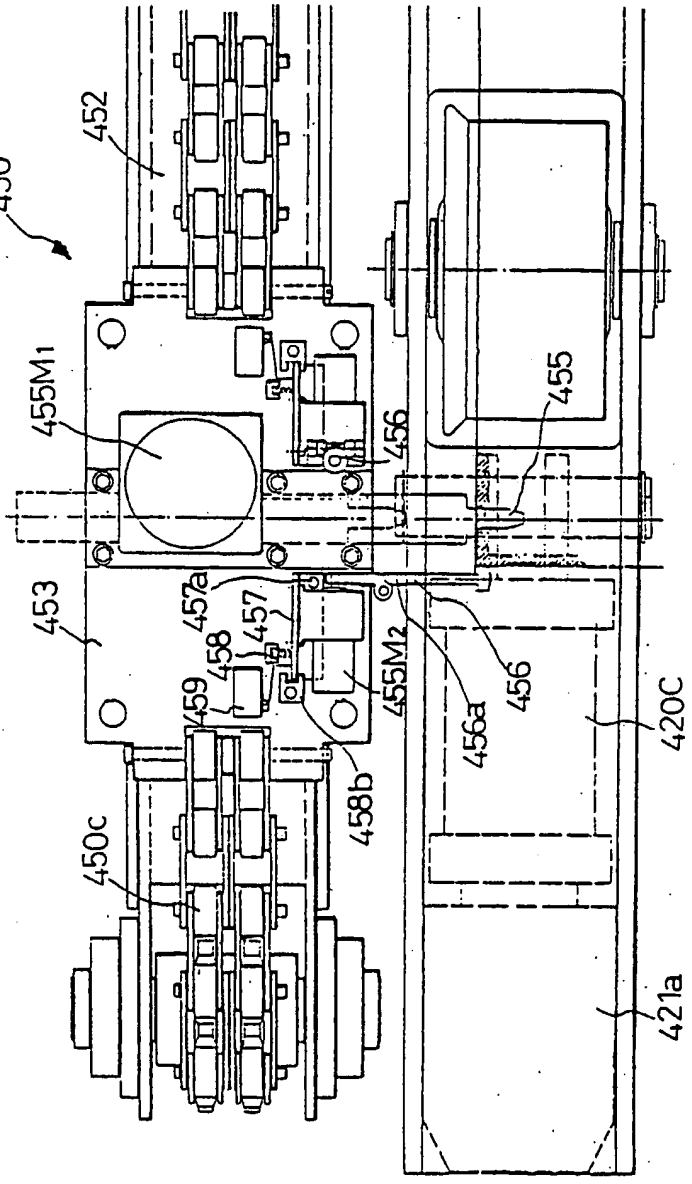
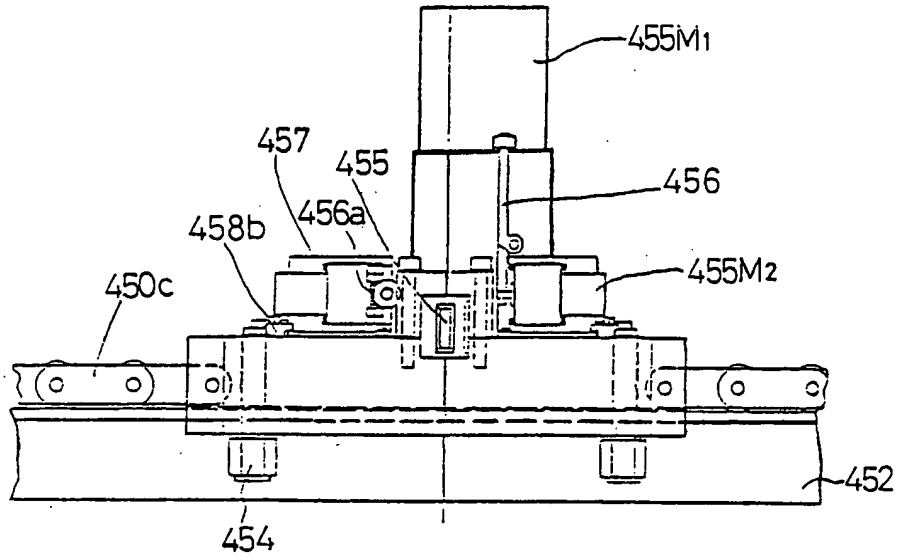

450
452
455M1
455
456
453
457a
457
458
459
455M2
456a
456
420C
458b
450c
421a

FIG. 8A

FIG. 8B



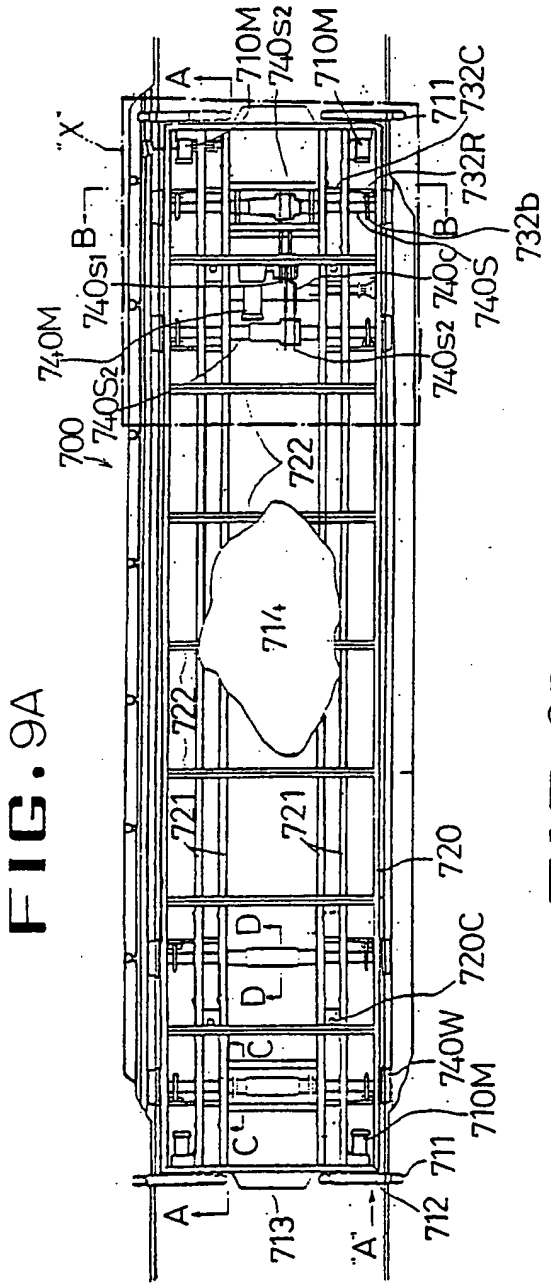

700
740M
740S2
740S1
B
"X"
A
710M
740S2
710M
711
732C
732R
732b
740S
740C
740S2
722
714
721
720
720C
740W
710M
711
712
713
"A"
C
D

FIG. 9A

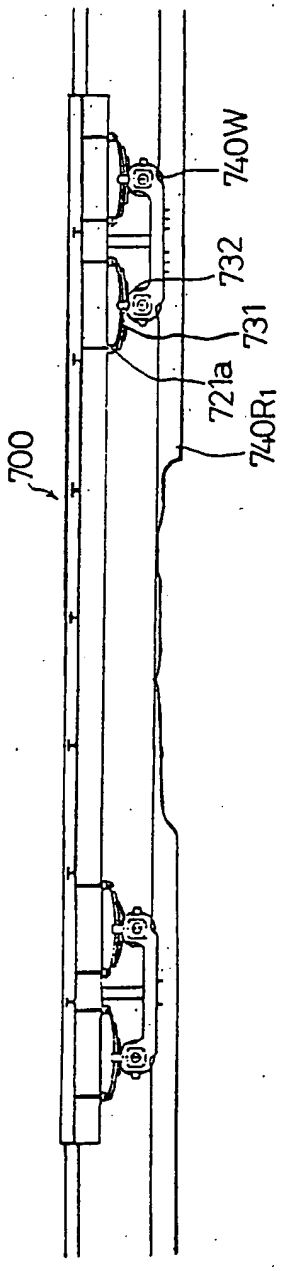

700
740W
732
731
721a
740R1

FIG. 9B

FIG. 9C

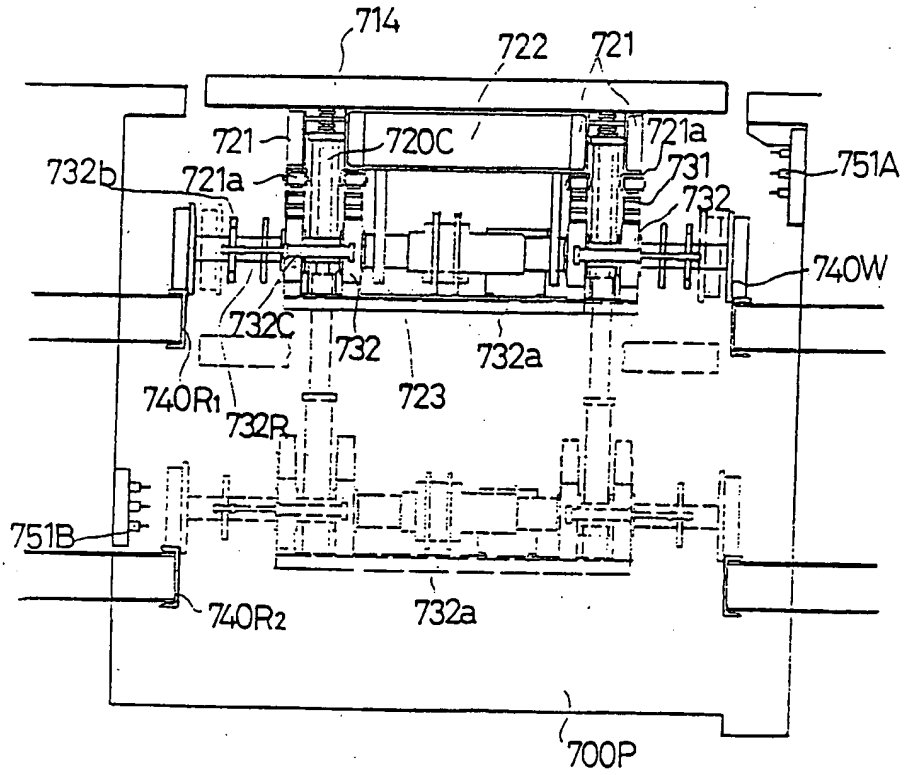

714
722
721
721
720C
721a
721a
731
732b
732
751A
740W
732C
732
732a
723
740R1
732R
751B
740R2
732a
700P

FIG. 9D

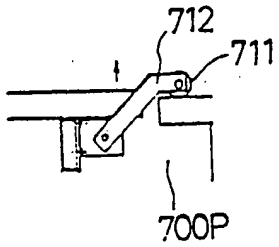


FIG. 9E

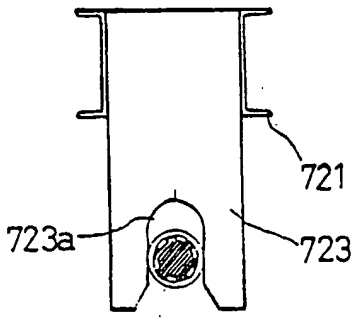


FIG. 9F

FIG.9G

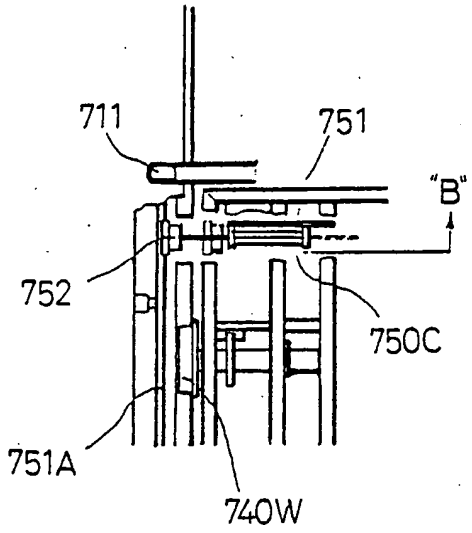


FIG.9H

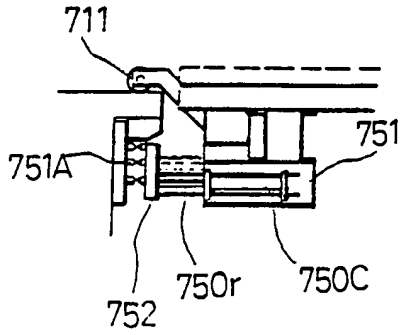


FIG.9I

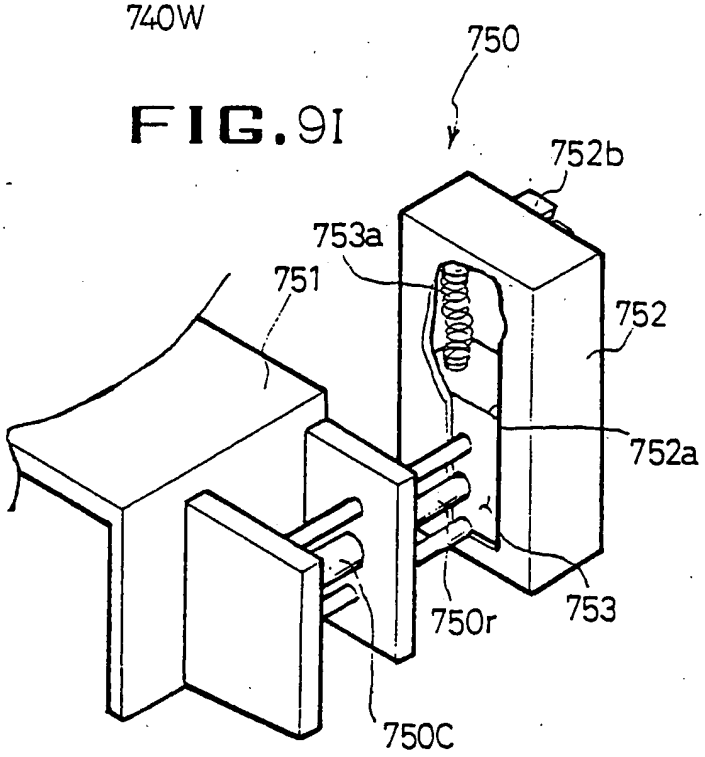
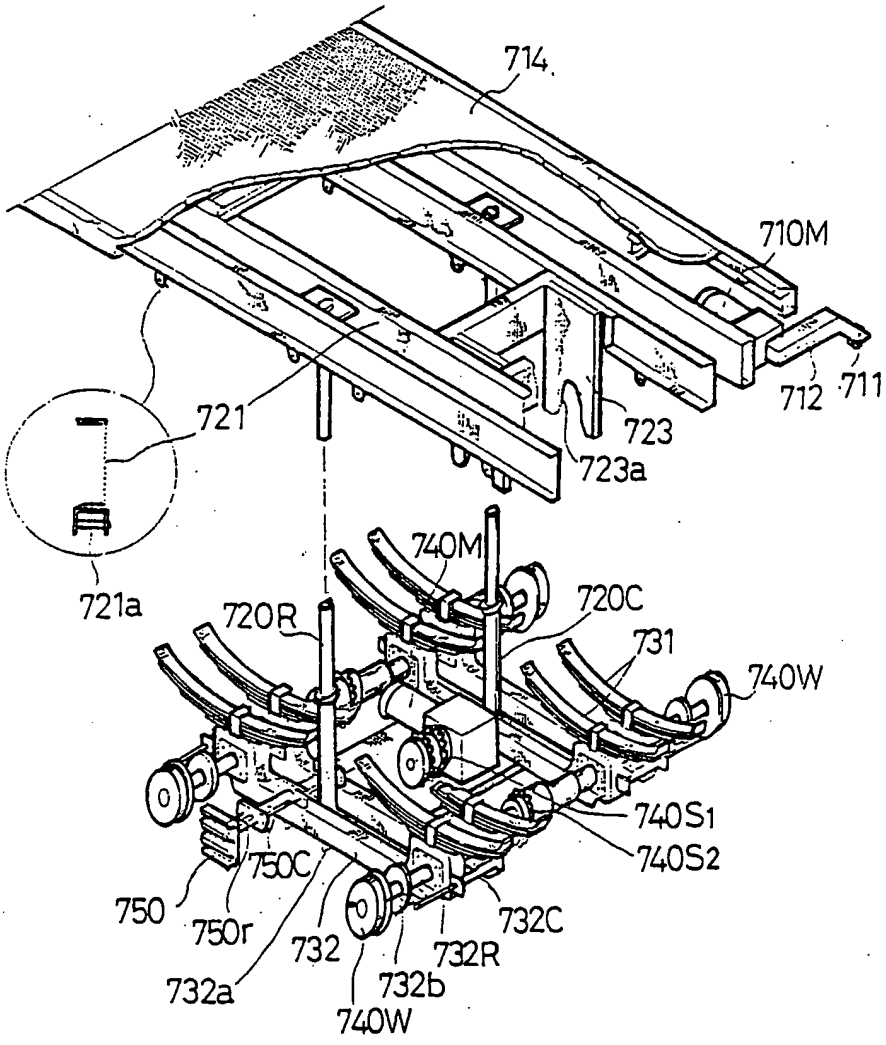


FIG. 9J


714
710M
712
711
721
723
723a
721a
740M
720C
720R
731
740W
740S1
740S2
750C
750
750r
732
732C
732R
732a
732b
740W

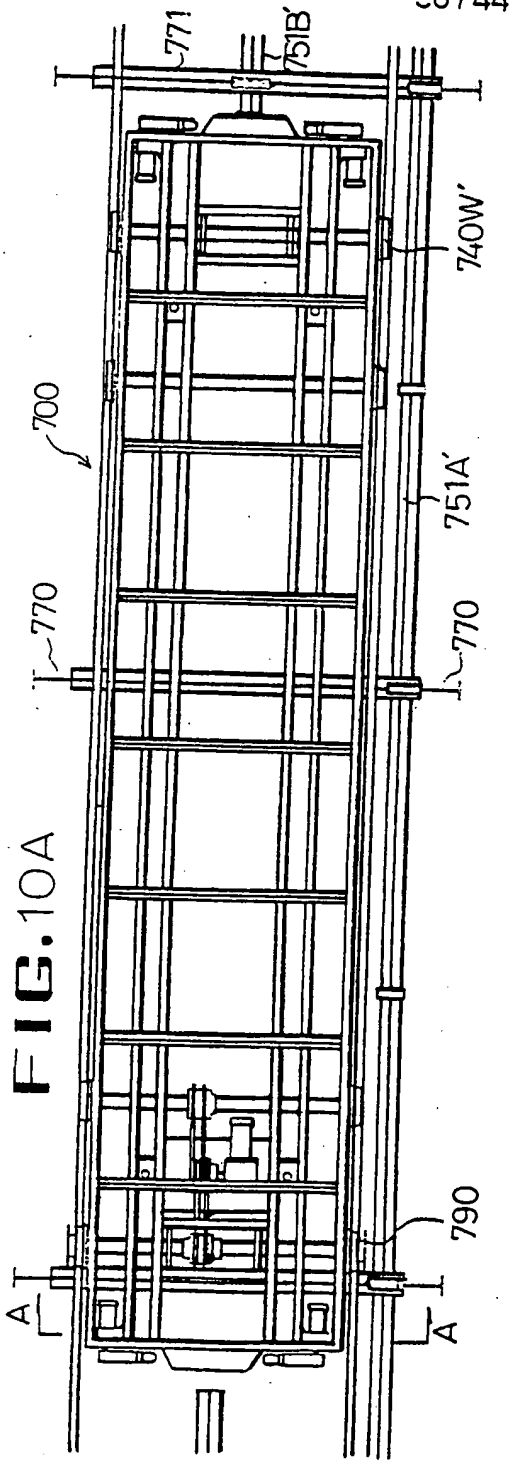


FIG. 10A

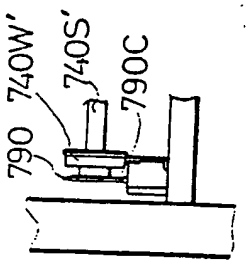


FIG. 10F

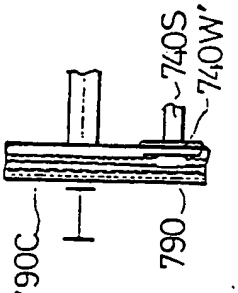


FIG. 10E

FIG. 10B

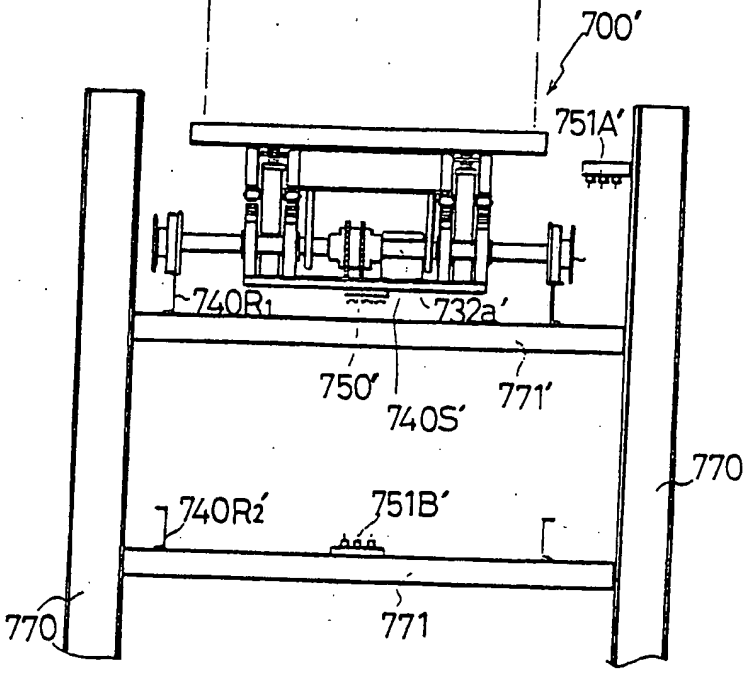


FIG. 10D

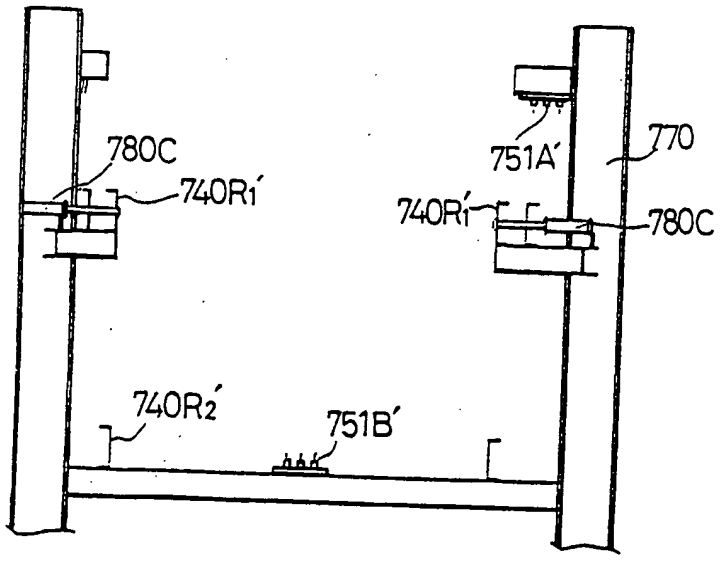
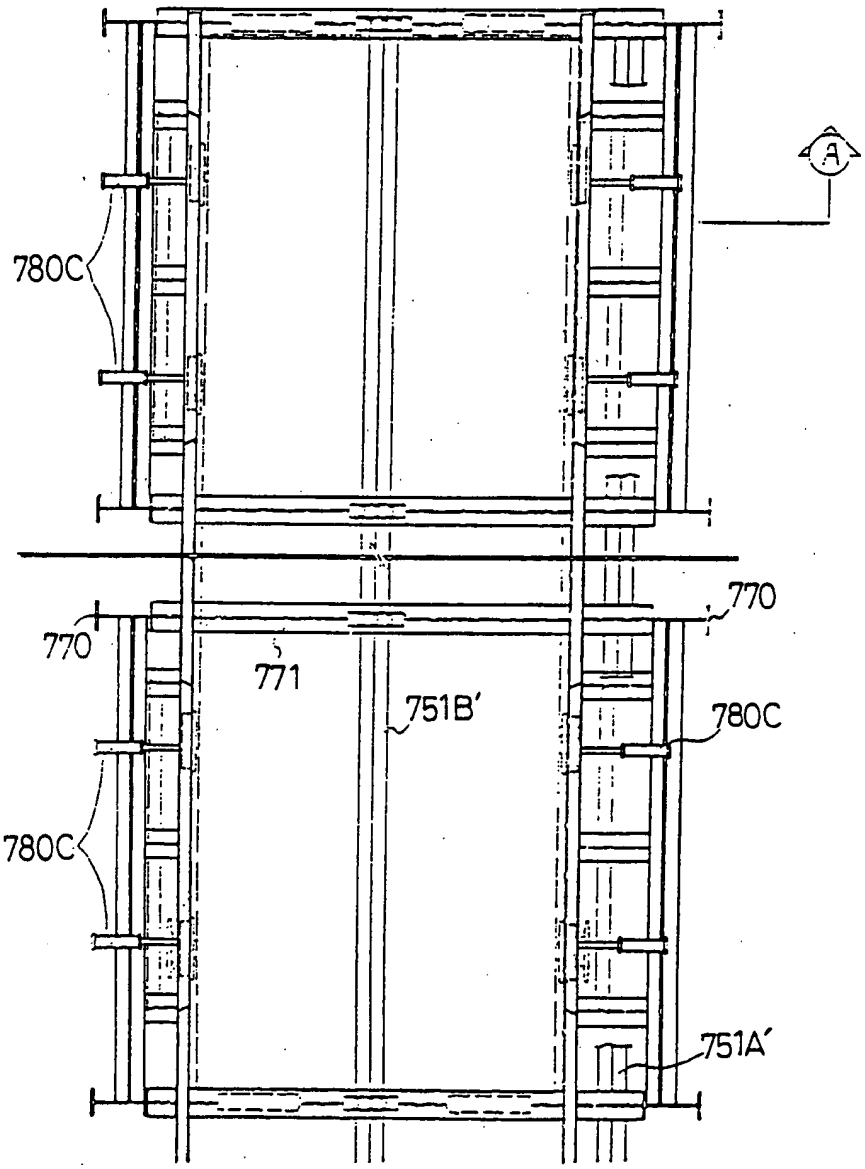


FIG. 10C



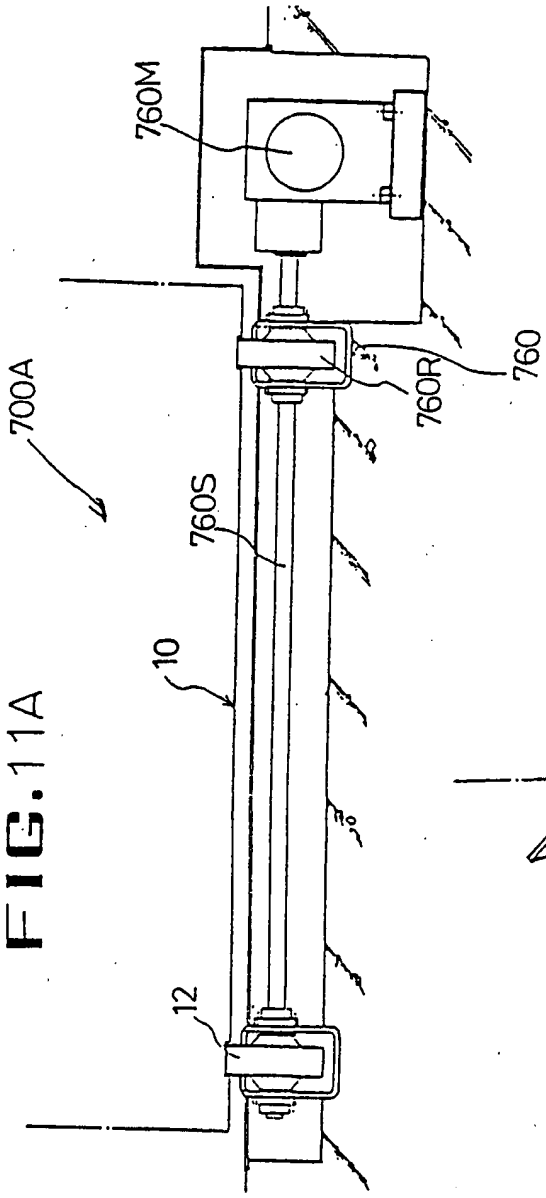


FIG.11A

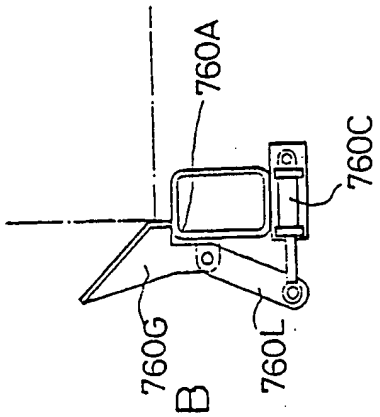


FIG.11B

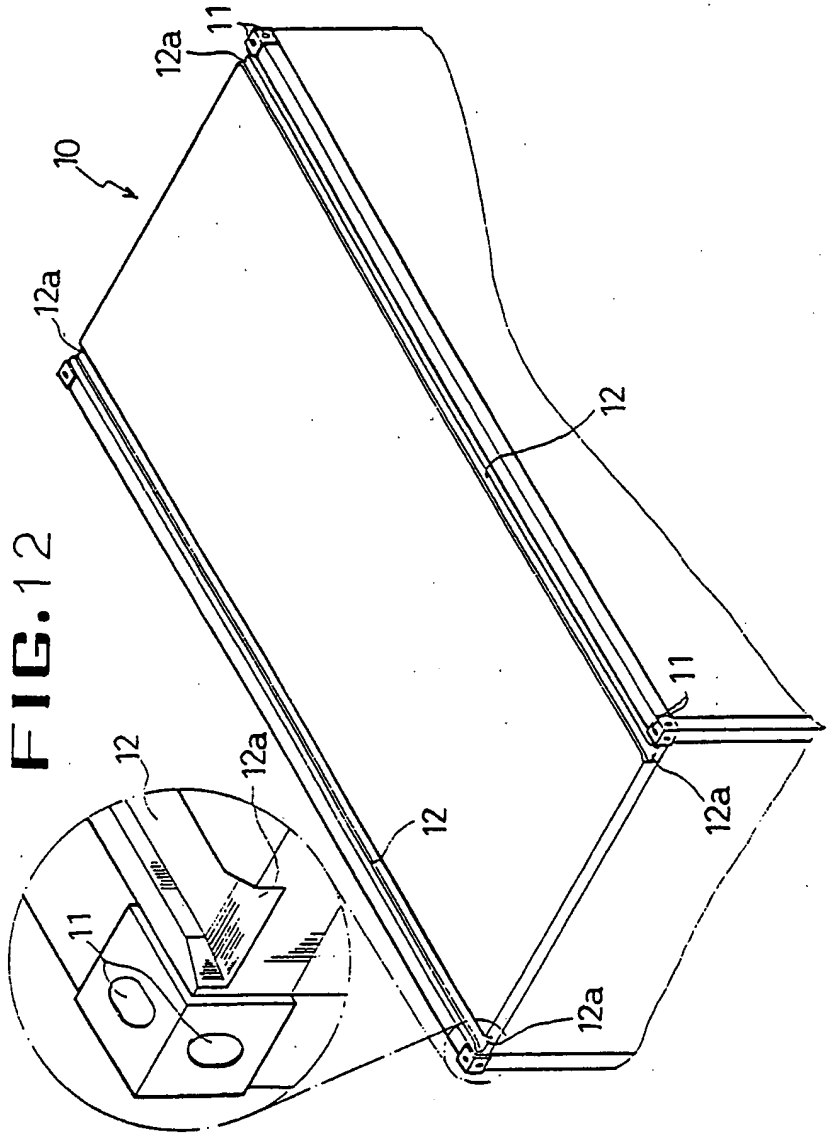


FIG. 12

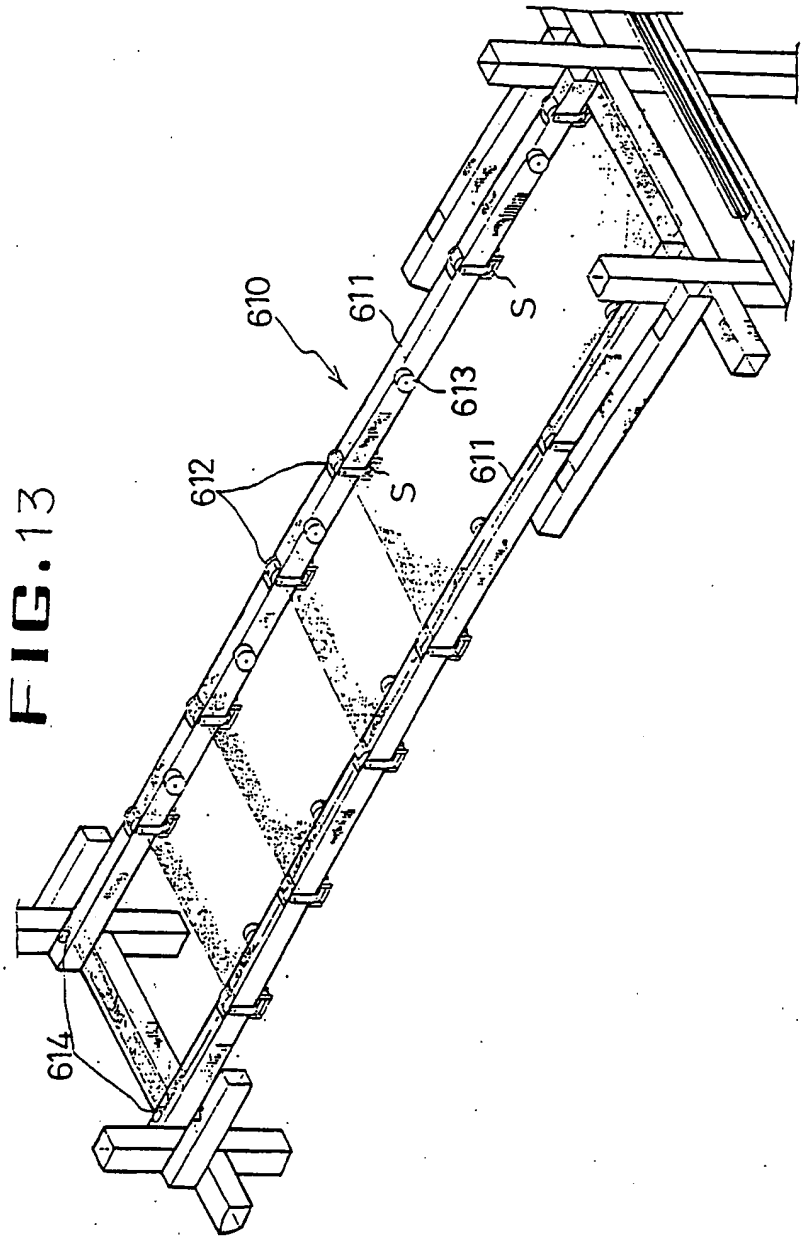


FIG. 13

FIG.14B

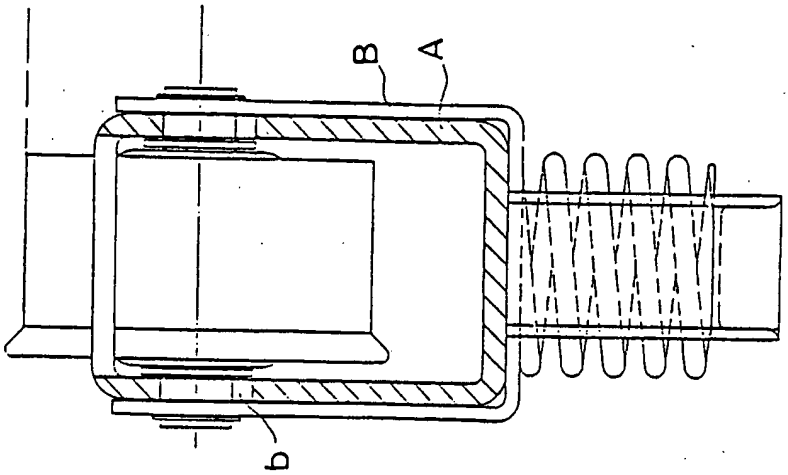


FIG.14A